Railway Mechanical Engineer

FOUNDED IN 1832

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PERSONAL MENTION OBITUARIES

SUPPLY TRADE NOTES

* Indicates photograph.

SUPPLY TRADE NEWS
OBITUARIES

* Indicates photograph.

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January 1941

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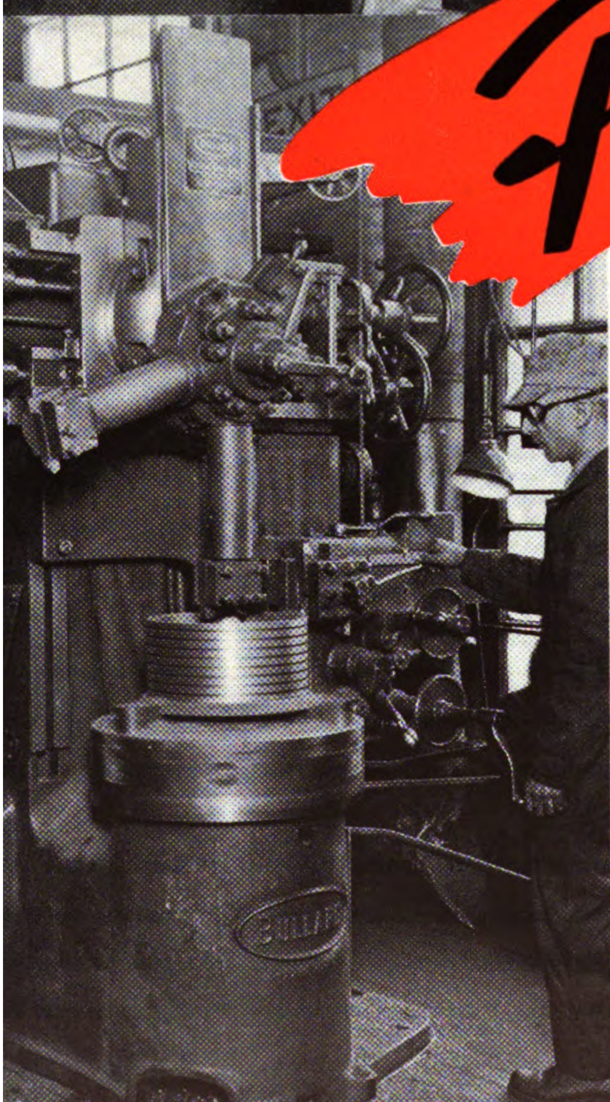

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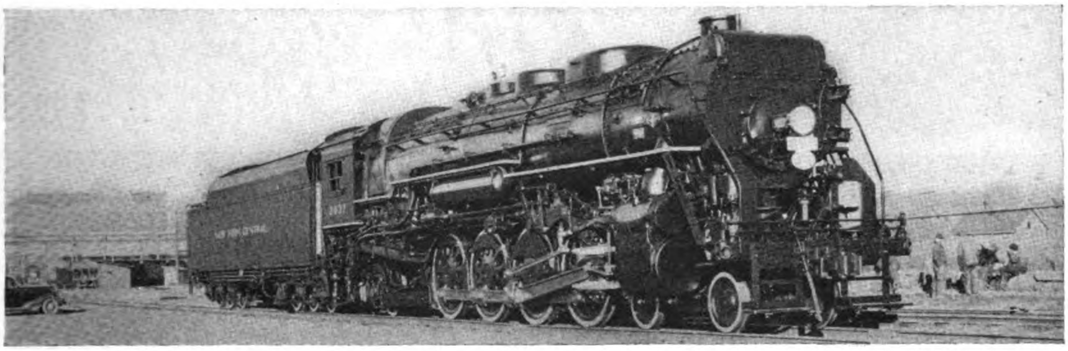

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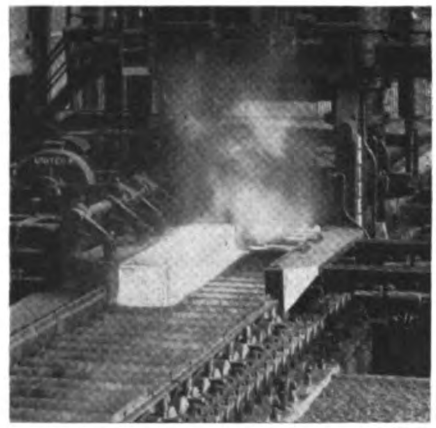

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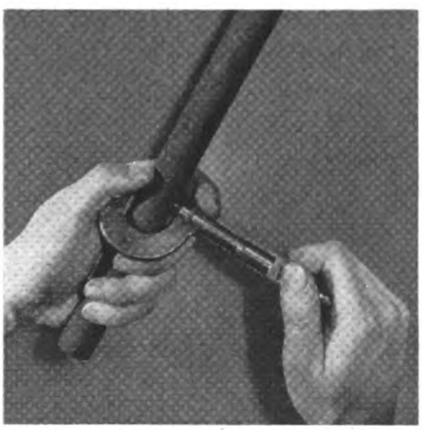

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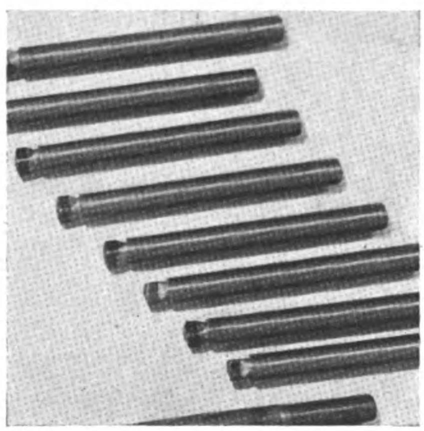

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BYERS
GENUINE WROUGHT IRON
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New York Central Buys 50

4-8-2 Type Locomotives

Half of this group of freight locomotives are completely fitted for main-line passenger service—Lightweight parts and improved balancing are important features

THE New York Central is now placing in service, as delivered, 50 locomotives of the 4-8-2 type. Twenty-five of these units are completely equipped for passenger and freight service while the remainder are fitted for freight service only. The passenger and freight locomotives are known as the railroad Class L-3a and were built by the American Locomotive Company. The freight locomotives are known as the L-3b Class and 10 of these were built by the same builder, while the remaining 15 freight locomotives were built by the Lima Locomotive Works.

Some time ago two L-2 Class locomotives were converted for high-speed service by the application of lightweight revolving and reciprocating parts and improved cross-balancing. These two locomotives were tested extensively to determine the comparative effect on track with 69-in. drivers of these locomotives and the 79-in. drivers of passenger locomotives at speeds from 60 to 85 m. p. h. The results indicated a performance for the converted locomotives equal to that of the locomotives designed specifically for passenger service. The principal features of the converted power have now been incorporated in the new L-3 Class locomotives.

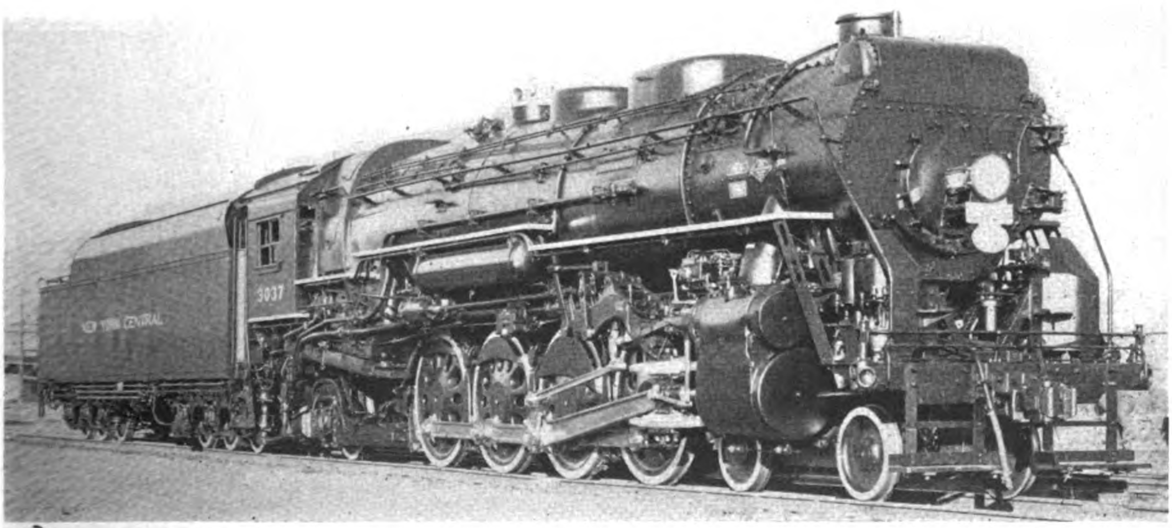
The new power is fitted with unusually large tenders having 43 tons fuel capacity and water capacity, because of the use of water scoops, is limited to 15,500 gal.

The Boiler

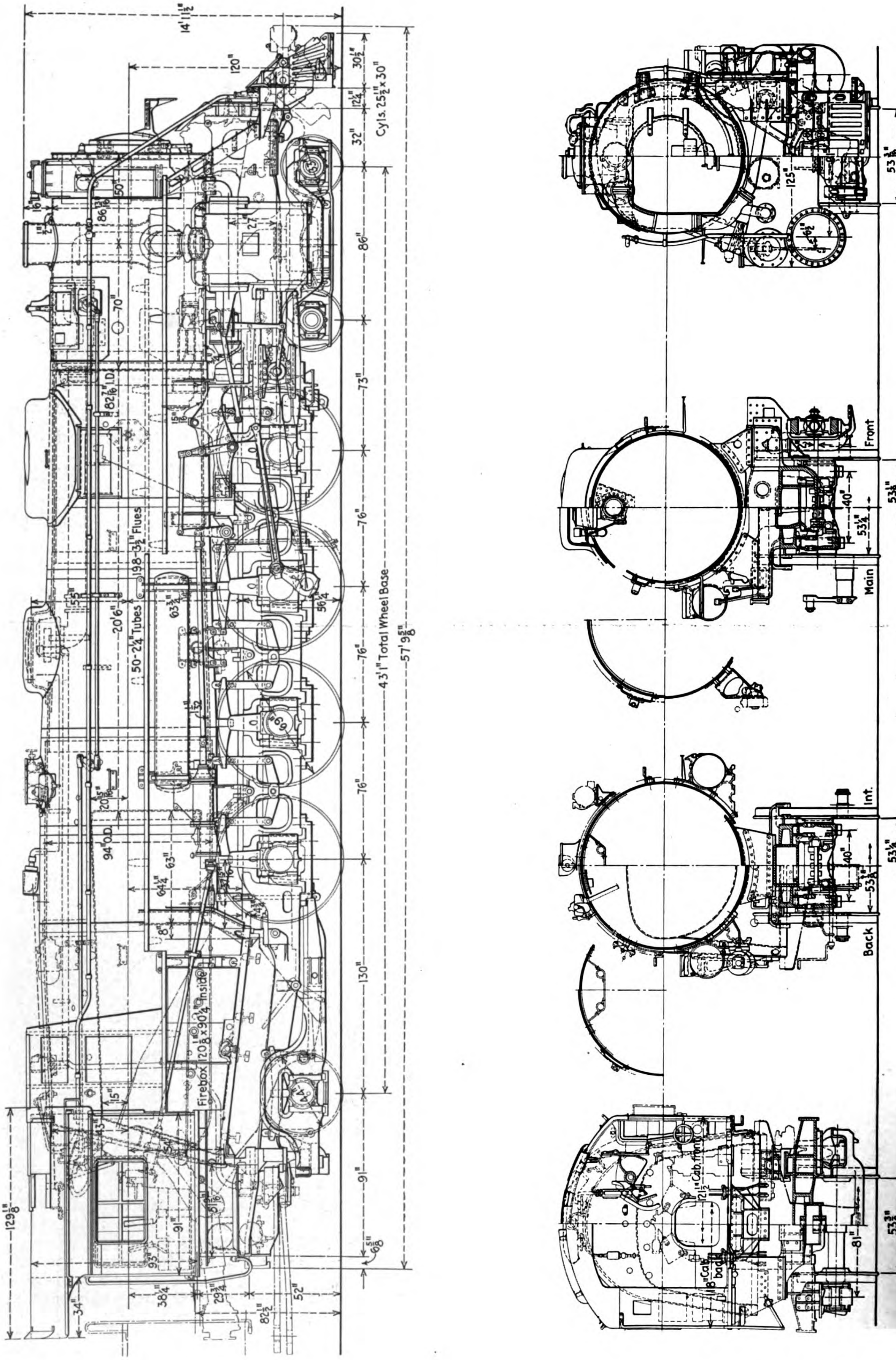
The boiler of the Class L-3 locomotives is of the conical type 82$\frac{7}{16}$ in. inside diameter at the first course and 94 in. outside diameter at the largest course. The boilers are designed for a working pressure of 255 lb. and the three 3½-in. safety valves are set to release at 250, 252, and 254 lb. The boiler is supported on the bed by waist sheets at the guide yoke and between each two pairs of drivers. Expansion shoes are used at the front and rear of the firebox. All boiler sheets are carbon steel and all rivets of soft steel. The principal boiler dimensions and proportions are shown in an accompanying table.

Welding is employed on all inside firebox seams. The flues are welded into the back flue sheet after final shop test. Seal welding of seams was used on the outside firebox at all four mud ring corners and the ends of the barrel-course longitudinal seams are butt-welded for 12 in. from the ends of the courses. In the throat sheet and inside back firebox sheets the five openings for the five 3-in. arch tubes are built up, by welding, from sheet thickness to ¾ in., and 4½ in. diameter to provide for greater tube bearing in the sheets.

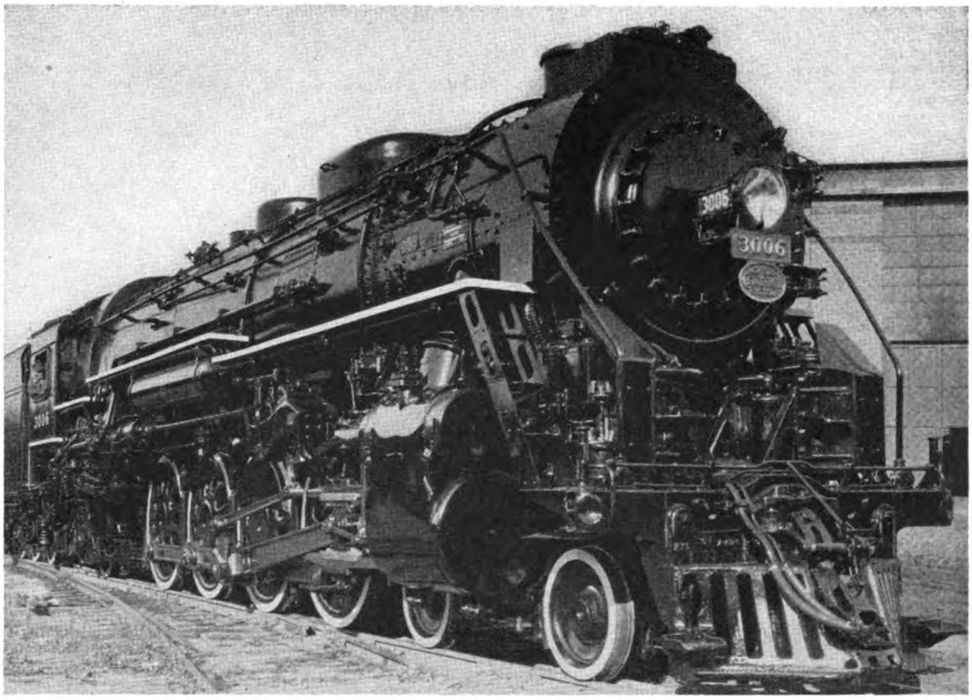
The firebox ring is cast steel, machined at all sheet and crosstie fits.



One of the freight locomotives built by Lima Locomotive Works



Erecting elevation and cross sections of the New York Central L-3a locomotive



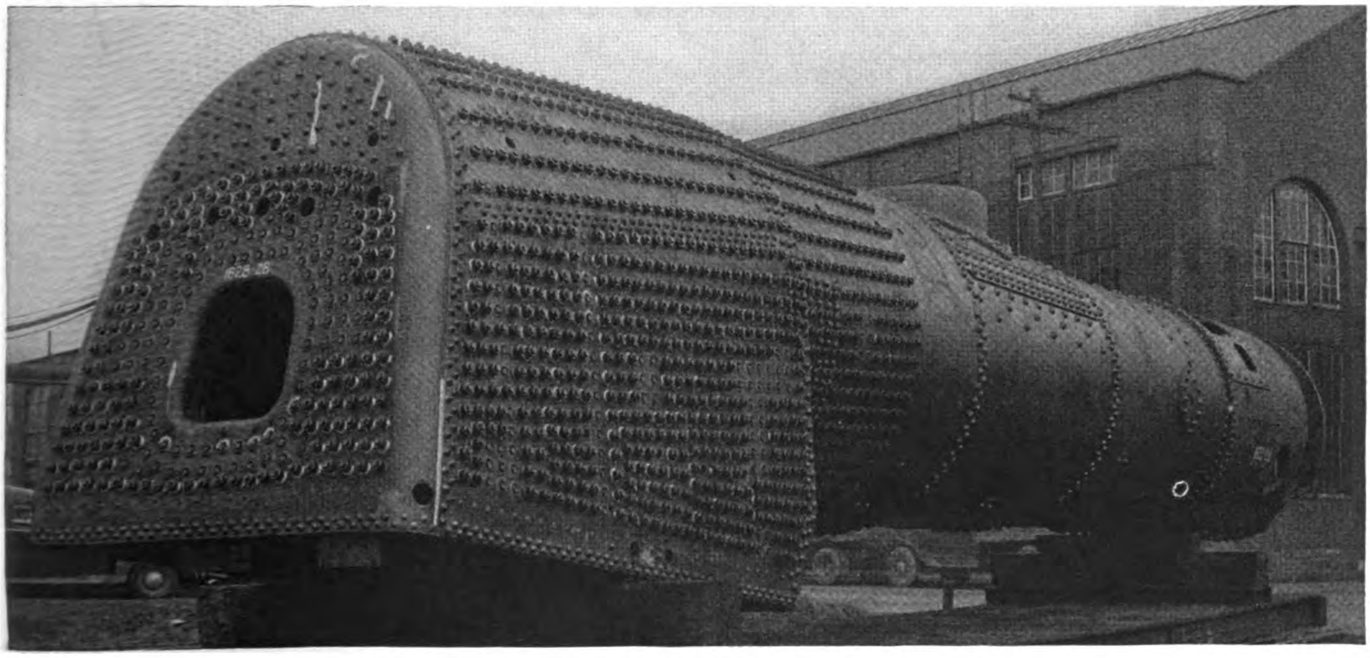
Locomotive No. 3006—one of those equipped for passenger service—at the Schenectady plant of the American Locomotive Company

All flexible firebox staybolts are the Flannery D Type head, hollow-drilled bolts. The crown stays, using UW sleeves and A caps, are in seven rows on each side of the shell starting with the fourth row from the top center line and running the full length of the firebox and combustion chamber back of three front rows of expansion stays. These expansion stays are in 10 rows each side of the top center line. There is a complete installation of flexible water space stays in the combusion chamber, throat, sides and back head except for one row above the mud ring. Where flush-type flexible are required, the FW sleeves with A caps are used.

Rigid crown stays are used in the three rows on each side of the top center line for the full length of the firebox and combustion chamber, back of the three front rows of expansion stays.

The bituminous coal is fed by a Standard HT stoker and burned on Firebar grates. The brick arch is supported on five 3-in. tubes. Water is supplied to the boilers by Nathan, Type 1918 B non-lifting injectors on the right side and feedwater heaters on the left. Worthington 5½ SA heaters are applied to the 35 Alco-built locomotives and the 15 built by Lima are equipped with Elesco K5OL heaters.

The boilers have Type E, 100-unit, single-loop, superheaters with American throttles integral with the headers. The steam pipes have an inside diameter of 8½ in. Steam dryers are used in the dome on both the 9⅜-in. main dry pipe and on the dry pipe leading to the main turret. The latter is located in the roof sheet outside the cab and the valve controls are conveniently arranged, and marked, on a panel over the back head near the cab roof. All auxiliaries, except blowers, operate on saturated steam from this turret. The blowers are supplied



The boiler is the conical type with combustion chamber and full flexible staybolt installation

Principal Dimensions, Weights and Proportions of the New York Central 4-8-2 Type Locomotives

Class	L-3a	L-3b	
Builder	Alco (25)	Alco (10)	Lima (15)
Road numbers	3000-3024	3025-3034	3035-3049
Date built	Nov.-Dec., 1940	Dec., 1940	
Service	Pass. and frt.	Freight	
Dimensions:			
Height to top of stack, ft.-in.	14—11½	14—11½	
Height to center of boiler, ft.-in.	10—0	10—0	
Width overall, ft.-in.	11—⅞	11—⅞	
Cylinder centers, in.	91	91	
Weights in working order, lb.:			
On drivers	262,000	*	265,000
On front truck	70,400	*	65,100
On trailing truck	56,100	*	63,400
Total engine	388,500	*	393,500
Tender (two-thirds loaded)	302,240	*	303,990
Wheel bases, ft.-in.:			
Driving	19—0	19—0	
Engine, total	43—1	43—1	
Engine and tender, total	95—11½	95—11½	
Wheels, diameter outside tires, in.:			
Driving	69	69	
Front truck	33	33	
Trailing truck	44	44	
Engine:			
Cylinder, number, diameter and stroke, in.	25½ x 30	25½ x 30	
Valve gear, type	Baker	Baker	
Valves, piston type, size, in.	14	14	
Maximum travel, in.	8½	8½	
Steam lap, in.	1 9/16	1 9/16	
Exhaust clearance, in.	5/16	5/16	
Lead, in.	5/16	5/16	
Cut-off in full gear, per cent	82	82	
Boiler:			
Type	Conical	Conical	
Steam pressure, lb. per sq. in.	250	250	
Diameter, first ring, inside, in.	82 7/16	82 7/16	
Diameter, largest outside, in.	94	94	
Firebox, length, in.	120⅛	120⅛	
Firebox, width, in.	90¼	90¼	
Height mud ring to crown sheet, back, in.	69	69	
Height mud ring to crown sheet, front, in.	89 15/16	89 15/16	
Combustion chamber length, in.	63	63	
Arch tubes, number and diameter, in.	5—3	5—3	
Tubes, number and diameter, in.	50—2¼	50—2¼	
Flues, number and diameter, in.	198—3½	198—3½	
Length over tube sheets, ft.-in.	20—6	20—6	
Fuel	Bituminous	Bituminous	

	L-3a	L-3b	
Grate area, sq. ft.	75.3		75.3
Heating surfaces, sq. ft.			
Firebox and comb. chamber	338		338
Arch tubes	35		35
Firebox, total	373		373
Tubes and flues	4,284		4,284
Evaporative, total	4,657		4,657
Superheating	2,080		2,080
Comb. evap. and superheat	6,737		6.737
Tender:			
Type	Rectangular		Rectangular
Water capacity, gal.	15,500		15,500
Fuel capacity, tons	43		43
Trucks	Six-wheel		Six-wheel
General data, estimated:			
Rated tractive force, engine, 85 per cent, lb.	60,100		60,100
Rated tractive force, booster, lb.	......		14,000
Total rated tractive force, lb.	......		74,100
Weight proportions:			
Weight on drivers ÷ weight engine, per cent	67.4	*	67.4
Weight on drivers ÷ tractive force	4.36	*	4.41
Weight of engine ÷ evap. heat. surface	83.5	*	84.5
Weight of engine ÷ comb. heat. surface	57.7	*	58.4
Boiler proportions:			
Firebox heat. surface per cent comb. heat. surface	5.54	5.54	
Tube-flue heat. surface, per cent comb. heat. surface	63.6	63.6	
Superheat. surface, per cent comb. heat. surface	30.9	30.9	
Firebox heat. surface ÷ grate area	4.96	4.96	
Tube-flue heat. surface ÷ grate area	56.9	56.9	
Superheat. surface ÷ grate area	27.6	27.6	
Comb. heat. surface ÷ grate area	89.5	89.5	
Evaporative heat. surface ÷ grate area	62.0	62.0	
Tractive force ÷ grate area	789.0	789.0	
Tractive force ÷ evap. heat. surface	12.9	12.9	
Tractive force ÷ comb. heat. surface	8.93	8.93	
Tractive force × diameter drivers ÷ comb. heat. surface	615.4	615.4	

*Weights of Alco L-3b locomotives not available.

with superheated steam from an auxiliary turret near the front end the blower valves in lines from this turret are controlled from the cab.

Other boiler accessories are shown in the accompanying list of equipment and materials.

Engine Bed, Wheels and Bearings

The engine bed, supplied by General Steel Castings Corporation embraces the cylinders and back heads, guide yoke and valve-motion supports, air-pump brackets and frame cross-members. The right and left main bed members are on 40-in. centers. The beds are all arranged for roller or friction-bearing application and have the wheel centers so spaced as to permit the installation of 72-in. drivers, if desired. Should this be done, the height of the locomotive will be increased 1½ in.

The spring rigging is the conventional equalizer and elliptic spring design with reverse camber driving springs. The hangers, links and intermediate equalizers are mild steel while the trailer truck and transverse equalizers are normalized carbon vanadium. The springs are carbon steel, with cast-steel saddles.

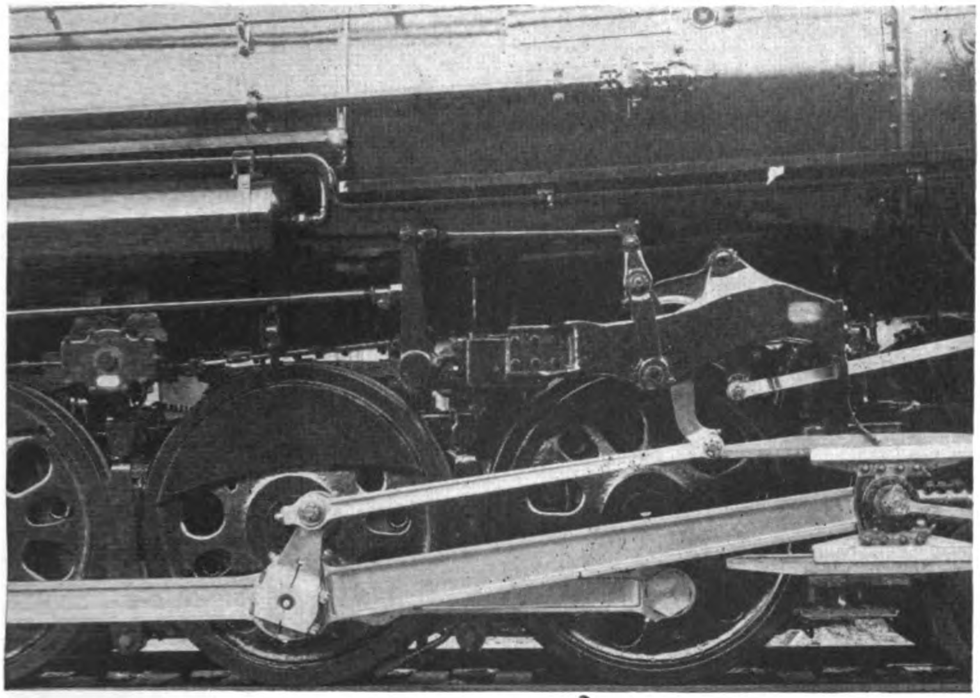
The driving wheels are the Boxpok type on 40 locomotives and the web-spoke type on the other 10. All four pairs of drivers are cross balanced. The overbalance at Nos. 1 and 4 wheels is 115 lb., 166 lb. at the No. 2, or main wheel, and 132 lb. at the No. 3 wheel. The dynamic augment at diametral speed is 7,950 lb. at the main wheel, 6,350 lb. at the No. 3 wheel, and 5,500 at the Nos. 1 and 4 wheels. This compares with the dynamic augment of the L-2d class of 13,900 lb. on the front and back wheels and 15,400 lb. on the main and intermediate drivers.

Twenty-five locomotives are equipped with carbon-vanadium driving axles and Timken roller bearings while the other 25 have medium carbon-steel axles and crown bearings. All driving axles are hollow bored, 4 in. diameter. The journal sizes on the roller-bearing axles

Comparison of Characteristics of New York Central 4-8-2 Locomotives

	L-2d Freight	L-2d converted 2998	L-3a Freight and Passenger	L-3a Freight
Builder	Alco	Alco	(25) Alco	(10) Alco (15) Lima
Road numbers	2925-2997; 2999	2998	3000-3024	3025-3034 3035-3049
Date built	Nov. 1929	Nov. 1929	Dec. 1940	
Service	Freight	Passenger and freight	Passenger and freight	Freight
Weight on drivers in working order, lb.	250,000	257,000	262,000	265,000
Total engine weight, in working order, lb.	370,150	385,100	388,500	393,500
Weight of tender, in working order, lb.	313,500	313,500	373,900	
Cylinders, diameter and stroke, in.	27 x 30	25½ x 30	25½ x 30	
Driving wheels, diam., in.	69	69	69	
Steam pressure, lb.	225	250	250	
Fuel	Bit. coal	Bit. coal	Bit. coal	
Grate area, sq. ft.	75.3	75.3	75.3	
Firebox heating surface, total, sq. ft.	354	354	373	
Evaporative heating surface, sq. ft.	4,556	4,556	4,657	
Superheating surface, sq. ft.	1,931	1,931	2,080	
Tractive force, engine, lb.	60,620	60,100	60,100	
Tractive force with booster	73,020	73,850	...	74,100*
Dynamic augment on main driver at diametral speed, lb.	15,400	7,950	7,950	

*Booster on freight locomotives only.



The valve motion and running gear — The side and main rods are manganese vanadium steel and the crosshead, piston and piston rod are Timken lightweight design

are 12$\frac{9}{16}$ in. for the main and 11$\frac{5}{8}$ in. for the others. On the plain-bearing axles, the journals are 12$\frac{1}{2}$ in. by

Lubrication—New York Central 4-8-2 Type Locomotives

	L-3a Alco (3000-3024)	L-3b Alco (3025-3034)	L-3b Lima (3035-3049)
Right-side lubricator-valve oil	Nathan DV-5, 26 pts. 7 feeds	Detroit Mod. B, 32 pts. 7 feeds	Detroit Mod. B, 32 pts. 6 feeds
No. of feeds:			
Cylinder and valves	4	4	4
Air pump	1	1	1
Stoker	1	1	1
Feedwater pump	1	1	None
Guides	None	None	None
Left-side lubricator-engine oil	Nathan DV-5, 26 pts., 10 feeds	Detroit Mod. B. 32 pts., 14 feeds	
No. of feeds and points lubricated:			
Engine-truck-wheel pedestals	2—8	2—8	
Valve-stem guides	1—4	1—4	
Main guides	1—2	1—2	
Driving-box hub face	None	2—8	
Driving-box pedestals	4—16	4—16	
Driving-box wedges	None	2—8	
Trailer-truck pedestals	1—4	1—4	
Trailer-truck center pin and radial buffer	1—3	1—3	
Total no. of feeds and points lubricated	10—37	14—53	
Engine-truck center plate	Oil cup	Oil cup	
Alemite hard grease fittings:			
Main and side rods	No. G-575		
Electrical rod, back end	No. G-575		
Main crank pin	No. 1267		
Alemite soft-grease fitting No. 1396:			
Valve gear, except valve-stem guides	With		
Valve-stem guides	None		
Reverse gear	With		
Reverse shaft bearings and arms	With		
Radial buffer	None		
Throttle-rod bearings	With		
Speed recorder	With		
Waterscoop piston-rod guide	With		
Waterscoop shaft bearings	With		
Trailer spring hanger pin	With		
Reach-rod guide, reverse gear	With		
Feedwater pump (Elesco)	None		
Lateral-motion device	With—Class L-3a only		
Side-rod knuckle pins	With		
Tender brake slack adjuster pull rod	With		
Rex valve-oil fitting No. 15: Crosshead roller-bearing wrist pin	With		
Tender-truck roller-bearing pedestals	With		
Throttle cam-shaft packing	Valve oil with separate oil cup		
Tender-truck center plate	Oil cup		

14 in. and 11 in. by 13 in., respectively. Magnus bearings and hub plates, and Franklin adjustable wedges and snubbers are used on these locomotives. The Alco lateral cushioning device is used on Nos. 1 and 2 wheels. Provision is made for future application on the intermediate or back wheels. The resistances at the front and main wheels, where this device is used, are 17 and 8 per cent, respectively. The lateral is $\frac{1}{2}$ in. and $\frac{5}{16}$ in., respectively.

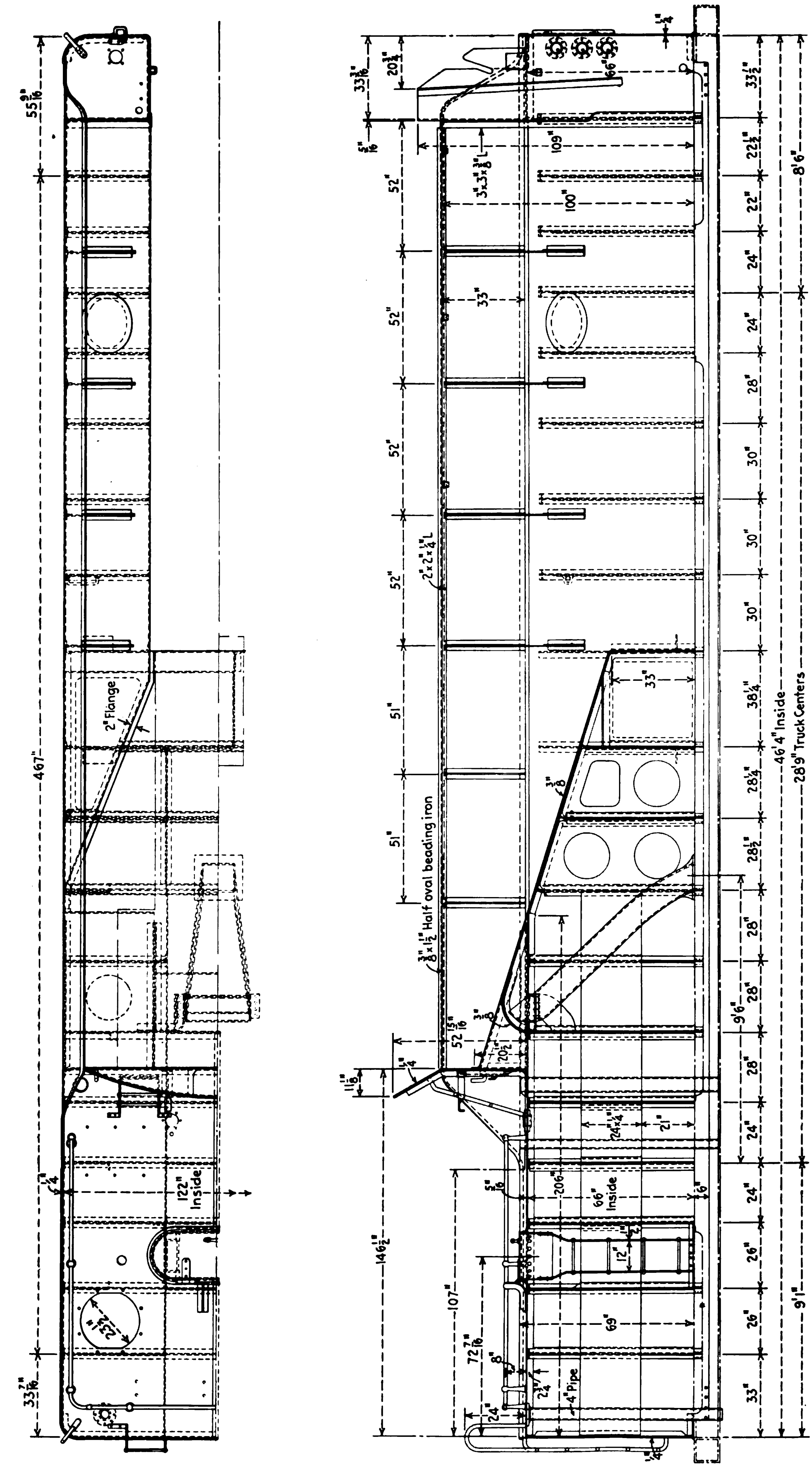
The engine truck is the General Steel Castings Corporation's constant resistance type with carbon-vanadium axles and roller bearings. Timken bearings on the passenger locomotives and SKF bearings on the freight locomotives. The trailer truck is the Delta outside-bearing type with Timken bearings mounted on carbon-steel axles. Provision is made for trailer brakes and on the freight locomotives for boosters which will be applied by the railroad.

The Running Gear

All bushings on the engine trucks and in the engine bed are Ex-Cell-O. The piston, piston-rod and crosshead assemblies were furnished by the Timken Roller Bearing Company. The heads are steel with American Hammered piston rings; the rods are chrome-nickel-molybdenum steel with the Timken grooved fit in the aluminum-alloy-shoe alligator-type crossheads. The wrist pins are case-hardened nickel-chrome steel. King type packing is used on the rods. The passenger power has $\frac{3}{8}$-in. head-to-head clearance, front and back and the freight locomotives $\frac{1}{4}$ in. at the back and $\frac{1}{2}$ in. at the front. The piston fits are interchangeable on all 50 locomotives.

The side and main rods are I-section manganese-vanadium steel, normalized and tempered. Hunt-Spiller gun iron with Magnus bronze bushings are used at the main pin floating bushings while the latter bushing material is used at all other pins. The main pins are normalized carbon-vanadium steel and the others are carbon steel, normalized and drawn. All crank pins are hollow bored.

Baker valve gear is used on all 50 locomotives. This gear is controlled by a Barco M-13 reverse gear on the freight locomotives and by a Franklin F-2 precision gear on the passenger locomotives.



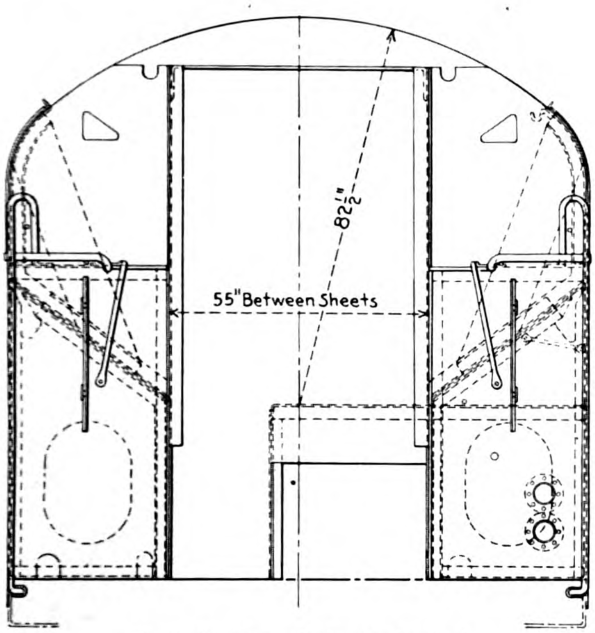
Plan and elevation of 15,500-gallon, 43-ton fuel capacity tender for the New York Central L-3 class locomotives

The Cab

The cabins built of No. 35½ hard, No. 8 gage aluminum with ⅜-in. steel rivets and wood lining. Aluminum is also used for angles, tees, bead and trim, gage board, cab-door frame, stationary rear windows and cab deck side sheets. The deck is diamond-pattern steel plate.

The cab is supported at the rear by a bracket on the bed and at the front by a patented cab saddle which allows for firebox expansion.

The cab interior is arranged for maximum accessibility to controls and has a single seat on the right side with two seats on the left side.



Front elevation of the tender tank

Lubrication

The extent to which mechanical and pressure grease lubrication has been used on these locomotives may be seen by reference to the accompanying table, indicating locations lubricated and the type of equipment used. The mechanical lubricators are mounted on the right and left sides of the engine and are actuated by linkage from the top of the combination lever.

Brake Equipment

The foundation brake equipment is the American Brake Company's design and the operating equipment

Partial List of Equipment and Materials on the New York Central 4-8-2 Type Locomotives

Engine bed; engine and trailer trucks; bumper beams; ash pans	General Steel Castings Corp., Eddystone, Pa.
Nickel cast-steel engine-bed pedestal caps; nickel-chromium-molybdenum steel forgings for all reciprocating parts other than main side rods	The International Nickel Company, Inc., New York.
Engine-bolt iron	Lockhart Iron & Steel Co., McKees Rock, Pa.
Hexagon nuts	(25) Scientific Production Corp., New York.
Pilots	(25) General Steel Castings Corp., Eddystone, Pa.
Springs	(25) American Locomotive Co., Railway Steel Spring Div., New York. (25) Crucible Steel Co. of America, New York.
Driving wheels	(40) General Steel Castings Corp., Eddystone, Pa. (10) Union Steel Castings Div. of Blaw-Knox Co., Albion, Mich.
Engine-truck and trailer wheels	(25) Carnegie-Illinois Steel Corp., Pittsburgh, Pa. (25) Armco Railroad Sales Co., Middletown, Ohio.
Tires	(35) American Locomotive Co., New York. (15) Bethlehem Steel Co., Bethlehem, Pa.
Lateral-cushioning devices	American Locomotive Co., New York.
Automatic compensators and snubbers	(25) Franklin Railway Supply Co., Inc., New York.
Hot-box alarms	(25) Magnus Metal Div., National Lead Co., New York. (25) The Timken Roller Bearing Company, Canton, Ohio.
Roller bearings: Driving wheels	(25) The Timken Roller Bearing Company, Canton, Ohio.
Engine truck	(25) The Timken Roller Bearing Company, Canton, Ohio. (25) SKF Industries, Philadelphia, Pa.
Trailer wheels	(50) The Timken Roller Bearing Company, Canton, Ohio.
Brake equipment	New York Air Brake Co., New York.
Engine-truck brakes	(25) American Brake Shoe & Foundry Co., New York.
Driver brakes	American Brake Shoe & Foundry Co., New York.
Coupler, drop	(25) National Malleable and Steel Castings Co., Cleveland, Ohio.
Uncoupling-shaft brackets	Standard Railway Equipment Co., Chicago.
Radial buffer	Franklin Railway Supply Co., Inc., New York.
Boiler and firebox steel	(25) Bethlehem Steel Co., Bethlehem, Pa. (25) Otis Steel Co., Cleveland, Ohio.
Firebox steel, deoxidized	(35) Lukens Steel Co., Coatesville, Pa.
Firebrick	(25) American Arch Co., Inc., New York. (25) General Refractories Co., Philadelphia, Pa.
Hot rolled steel sheets	(35) Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Boiler studs	Crucible Steel Co. of America, New York.
Staybolt iron	Joseph T. Ryerson, Inc., Chicago.
Flexible staybolts and sleeves	Flannery Bolt Co., Bridgeville, Pa.
Steel tubes and flues	(5) Steel & Tubes, Inc., Cleveland, Ohio.
Boiler and cylinder lagging	Johns-Manville Sales Corp., New York.
Boiler jacket	Carnegie-Illinois Steel Corp., Pittsburgh, Pa.
Blower valves	(25) The Lunkenheimer Company, Cincinnati, Ohio.

The tender coal capacity is 43 tons

Steam-pipe casing	(35) American Locomotive Co., New York. (15) Lima Locomotive Works, Lima, Ohio.
Superheater	The Superheater Company, New York.
Superheater units	(25) Steel & Tubes, Inc., Cleveland, Ohio. (25) Pittsburgh Steel Co., Pittsburgh, Pa.
Throttle	American Throttle Co., New York.
Throttle air-joint packing	(35) The Garlock Packing Company, Palmyra, N. Y.
Steam drier:	
Main dry pipe	The Superheater Company, New York.
Turret dry pipe	Dri Steam Valve Sales Corp., New York.
Smokebox hinges	The Okadee Co., Chicago.
Smokebox screen	(35) Wickwire Spencer Steel Co., New York. (15) The W. S. Tyler Co., Cleveland, Ohio.
Feedwater heater	(35) Worthington Pump and Machinery Corp., Harrison, N. J. (15) The Superheater Company, New York.
Feedwater strainers	The Okadee Company, Chicago.
Injector, non-lift; boiler checks, injector type and feedwater heater	Nathan Manufacturing Co., New York.
Deck sprinklers	Locomotive Equipment Division of Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Blow-off cocks	(25) The Okadee Company, Chicago. (25) Wilson Engineering Corp., Chicago.
Blower-pipe elbows	Barco Manufacturing Co., Chicago.
Washout plugs, arch tube, cylinder port, tank drain and smokebox inspection	Huron Mfg., Detroit, Mich.
Continuous blowdown	National Aluminate Corp., Chicago.
Stoker	Standard Stoker Co., Inc., New York.
Grates	Waugh Equipment Co., New York.
Ash-pan flusher	The Okadee Company, Chicago.
Fire door	Standard Railway Equipment Co., Chicago.
Cylinder bushings; piston-valve bushings; valve bull rings; valve-packing-ring castings; outer bushings	Hunt-Spiller Manufacturing Corporation, Boston, Mass.
Steel bushings	Ex-Cell-O Corporation, Detroit, Mich.
Cylinder cocks	The Okadee Company, Chicago.
Piston and piston rod	The Timken Roller Bearing Company, Canton, Ohio.
Piston-rod and valve-stem packing	U. S. Metallic Packing Co., Philadelphia, Pa.
Piston packing rings	Koppers Company, American Hammered Piston Ring Div., Baltimore, Md.
Manganese vanadium alloy in rods	Vanadium Corp. of America, New York.
Valve gear	Pilliod Co., New York.
Crosshead	The Timken Roller Bearing Company, Canton, Ohio.
Drawbar (Safety bar)	Franklin Railway Supply Co., Inc., New York.
Top guides, floating	American Locomotive Co., New York.
Bearing metal for driving-boxes, rods, and miscellaneous	Magnus Metal Div., National Lead Co., New York.
Reverse gear	(25) Franklin Railway Supply Co., Inc., New York. (25) Barco Manufacturing Co., Chicago.
Reverse-gear flexible connection	Packless Metal Products Corp., Long Island City, N. Y.
Aluminum cab, running boards, dome and steam-turret casing	Aluminum Co. of America, Pittsburgh, Pa.
Cab side windshield	American Locomotive Co., New York.
Cab side windows	The O. M. Edwards Co., Inc., Syracuse, N. Y.
Cab seat box cushions	Sponge Rubber Products Co., Derby, Conn.
Clear vision windows	The Prime Manufacturing Co., Milwaukee, Wis.
Shatterproof glass	(35) Pittsburgh Plate Glass Co., Pittsburgh, Pa.
Cab curtains	Lehon Co., Chicago.
Cab apron	Alan Wood Steel Co., Conshohocken, Pa.
Air gages	Ashton Valve Co., Boston, Mass.
Steam gages, water-level indicator, safety valves	Locomotive Equipment Division of Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Miscellaneous cocks and valves	(25) Ohio Injector Co., Wadsworth, Ohio. (10) Walworth Company, New York. (15) Crane Co., Chicago.
Water column	Nathan Manufacturing Co., New York.
Water-gage glass	Corning Glass Works, Corning, N. Y.
Water-gage guard	The Okadee Company, Chicago.
Sander valves and traps	Graham-White Sander Corp., Roanoke, Va.
Low-water alarm	Barco Manufacturing Co., Chicago.
Sander hose	(35) United States Rubber Co., New York. (15) New York Air Brake Co., New York.
Train control	General Railway Signal Co., Rochester, N. Y.
Cut-off and speed recorder	Valve Pilot Corporation, New York.
Whistle-operating equipment	Viloco Railway Equipment Co., Chicago.
Bell ringer	Railway Service and Supply Corp., Indianapolis, Ind.
Bell chain	American Chain Div. of American Chain & Cable Co., Inc., Bridgeport, Conn.
Marker lamps	(35) Lovell-Dressel Co., Inc., Arlington, N. J.
Headlight generator, electric fittings, cab lamps	Pyle-National Co., Chicago.
Steam hose	Quaker City Rubber Co., Philadelphia, Pa.
Steam-heat regulator	Vapor Car Heating Co., Inc., Chicago.
Copper piping	(25) Phelps Dodge Copper Products Corp., New York.
Pipe-clamping system	Franklin Railway Supply Co., Inc., New York.
Pipe insulation	Union Asbestos & Rubber Co., Chicago.
Wrought-iron pipe	(35) A. M. Byers Co., Pittsburgh, Pa. (15) Cohoes Rolling Mill Co., Cohoes, N. Y.
Universal joints	The Okadee Co., Chicago.
Lubricators, mechanical	(25) Nathan Manufacturing Co., New York. (25) Detroit Lubricator Co., Detroit, Mich.
Grease fittings	Alemite Div. Stewart-Warner Corp., Chicago.
Oil fittings	Universal Lubricator Systems, Oakmont, Pa.
Hose for grease connection at air pumps	Chicago Pneumatic Tool Co., New York.
Oil-resistant hose	(35) The Flex-O-Tube Co., Detroit, Mich.
Oil cans	(25) Johnson Mfg. Co., Urbana, Ill.
Valve oil	(35) Socony Vacuum Oil Co., Inc., New York.
Flexible connections between engine and tender and at generator	Barco Manufacturing Co., Chicago.
Paint	(35) E. I. duPont de Nemours & Co., Wilmington, Del. (15) The Glidden Co., Cleveland, Ohio.
Welding wire	The Lincoln Electric Co., Cleveland, Ohio. Magnus Metal Div., National Lead Co., New York. John A. Roebling's Sons Co., Trenton, N. J.
Torpedoes	(35) Standard Railway Fusee Corp., Boonton, N. J.
Tender:	
Frame	General Steel Castings Corp., Eddystone, Pa.
Wheels	(25) Carnegie-Illinois Steel Corp., Pittsburgh, Pa. (25) Armco Railroad Sales Co., Middletown, Ohio.
Truck-box housings (on Alco locomotives)	Clails Equipment, Buchanan, Mich. Electric Steel Castings Co., Indianapolis, Ind.
Roller bearings	(25) The Timken Roller Bearing Co., Canton, Ohio. (25) SKF Industries, Philadelphia, Pa.
Simplex clasp and body brake	American Steel Foundries, Chicago.
Brake shoes	American Brake Shoe & Foundry Co., New York.
Draft gear	Waugh Equipment Co., New York.
Coupler and two-key draft-gear attachment	Symington Gould Corp., Rochester, N. Y.
Uncoupling shaft brackets	Union Metal Products Co., Chicago.
Tank-filling hole cover lock	Ramapo Ajax Div., American Brake Shoe & Foundry Co., New York.
Coal pusher	Standard Stoker Co., Inc., New York.
Water-level indicator	Locomotive Equipment Div. of Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Waterscoop cylinder relief valves	New York Air Brake Co., New York.

is the New York Air Brake Company's Schedule 8ET with two 8½-in. 120-cu.-ft.-per-min. cross-compound compressors mounted on the bed ahead of the smokebox. These compressors are equipped with air filters having removable cartridges. The engine trucks of the passenger locomotives, Class L3a, have brakes with cylinders on the truck frames. The passenger power is also equipped with train signal and steam heat.

The main sand box has a capacity of 2,700 lb. Graham-White sanders are used on the drivers of all 50 locomotives and on the trailer wheels of the L3a locomotives. The driving-wheel sanders are manually operated and the trailer sanders are automatically operated.

(Continued on page 21)

Illinois Central Installs Two

Oil-Hydraulic Rail Cars

Deluxe motor cars, for main-line service, are each powered with two 225-hp. Waukesha-Hesselman spark-ignition oil engines, are air conditioned and built of alloy steel

WITHIN the past month the American Car and Foundry Company has delivered, from its Berwick, Pa., plant, two lightweight, alloy-steel rail cars to the Illinois Central. One of the cars will operate on a 183.1 mile run between Jackson, Miss., and New Orleans, La., and is named "Miss Lou" after the two states. The other car, named the "Illini," will cover a 126.4-mile run between Chicago and Champaign, Ill. The operating schedule for these cars calls for average speeds of 45.8 and 49.1 m. p. h., respectively.

The two cars are similar in general arrangement and construction, are styled alike in the interiors but differ principally in the location of toilet and buffet facilities and the center entrance of the Miss Lou.

Each car is built of low-alloy, high-tensile steels and is designed to withstand the 100,000-lb. buffing load which complies with railway mail service requirements for a series of coupled cars of a total light weight of 300,000 lb. on the rails. Power is supplied by two 225-hp. oil engines through Twin-Disc clutches and torque converters to a geared axle drive on each truck.

The cars are capable of a maximum speed of 73.5 m. p. h. and can attain that speed on level tangent track in 2 min. 55 sec. over a distance of 2.0 miles.

The Car Structure

The underframe is built up of rolled Z-section side sill members to which the transverse equipment supports and the floor supports are welded. Rolled channel-shaped center sills are welded in fore and aft of the bolster in order to carry the buffing loads back to the bolster and first crossbearer and thence to the side girders. A combination of rolled Z-shapes spanning from side sill to side sill and insulated from the car floor are welded in to facilitate three-point suspension of the pancake engines mounted beneath the floor.

The bolster is of welded construction consisting of top and bottom cover plates which are welded to web plates. Flange stiffeners and gussets are welded in at the vulnerable points in order that the stresses will be smoothly transferred.

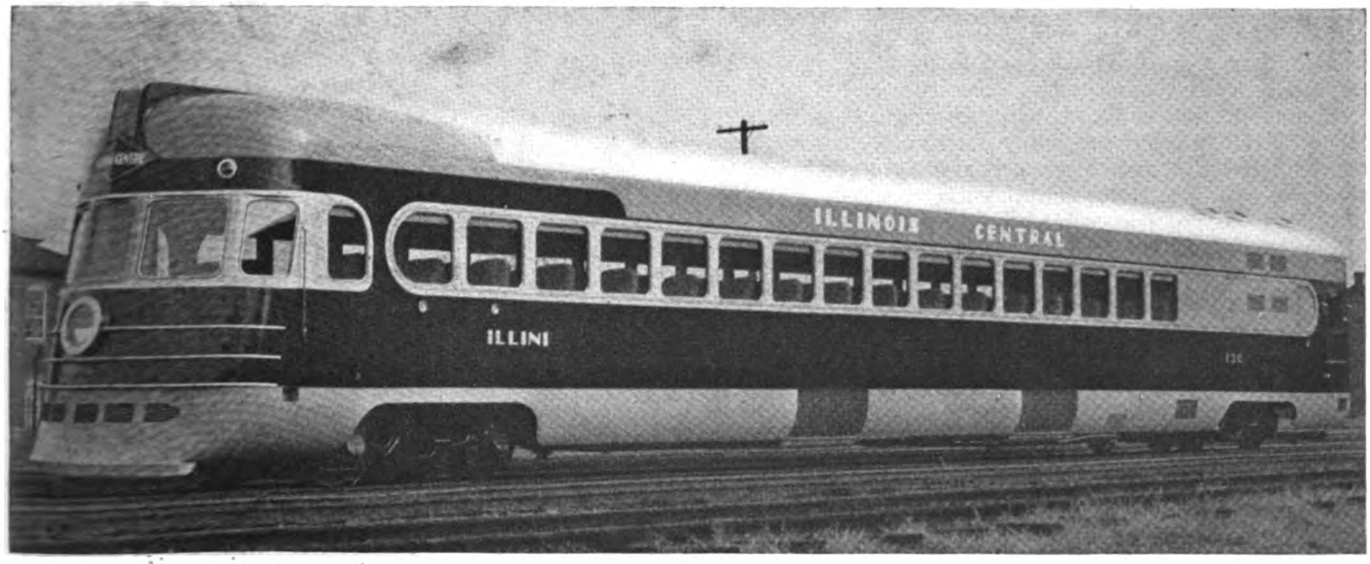
By means of this box section and lightening holes on the neutral axis an exceedingly light bolster was obtained with a comparatively high safety factor.

Light gage steel false floor sheets were then welded to the above mentioned underframe members, thus forming a water-tight and fireproof bottom covering for the floor.

Weights and Dimensions of Illinois Central Rail Cars

Light weight of body shell, lb.	20,750
Light weight of finished car body on center plates, lb.	64,589
Trucks, lb.	20,720
Total light weight on the rails, lb.	85,309
Estimated water, fuel, oil, crew, etc., lb.	4,300
Total service weight on the rails, lb.	89,609
Total load, passengers, lb.	10,350
Total loaded weight on the rails, lb.	99,959
Length overall, ft.-in.	75 — 0
Width overall, side frame, ft.-in.	9 — 6
Height, rail to top of roof, ft.-in.	11 — 8¾
Height, rail to top of floor, ft.-in.	3 — 5⅛
Height, floor to ceiling air duct, ft.-in.	7 — 2
Seating capacity on the Illini	69
Seating capacity on the Miss Lou	61

The side frame is of girder-type construction with a rolled angle side sill or bottom chord and a light-weight rolled Z-bar side plate or top chord member. The posts are a pressed flanged U-section which when spot welded to the 14-gage side sheets form a very stiff, but light-weight box section.



The "Illini" will operate between Chicago and Champaign, Ill.

The buffet and saloons are at the rear end of the Illini (as shown here) and grouped at the center of the Miss Lou—The interior decorative schemes are alike on both cars

The belt rails and window headers consist of pressed Z-shaped members, and are so arc welded to the side posts that they function as continuous members.

All of these framing members are first carefully jigged for location and alinement and then arc-welded together forming a skeleton or backbone to which the side sheets are then spot welded. All framing members are USS Cor-Ten steel.

The roof framing consists of a lightweight side plate angle to which is arc welded pressed Z-shaped carlines. Four Z-shaped purlines are welded to the carlines and run the entire length of the car and when riveted together with the carlines and the $\frac{1}{16}$-in. aluminum roof sheets form a stiff sub-assembly which when finally riveted to the side frames makes an extremely stiff unit. Further rigidity is gained by the light trussed framing which is fastened beneath the carlines to support the headlining and the air-conditioning duct, as well as the Pyle National center ceiling and low-pressure duct.

Both end frames are built up of welded construction with substantial end posts from the center sills at the bottom to the anti-telescoping sheet at the top. Both front and rear ends are designed to meet the new railway mail service requirements. The front end is made to accommodate five windows which give the operator excellent vision around the entire front of the car. The rear end has a standard coupler and draft gear and is equipped with face plates and diaphragms for the possible addition of a trailer at some later date.

The side sheathing of these cars is Armco high-tensile steel. The car sides, ends, roof and floor are insulated with Johns-Manville Stonefelt.

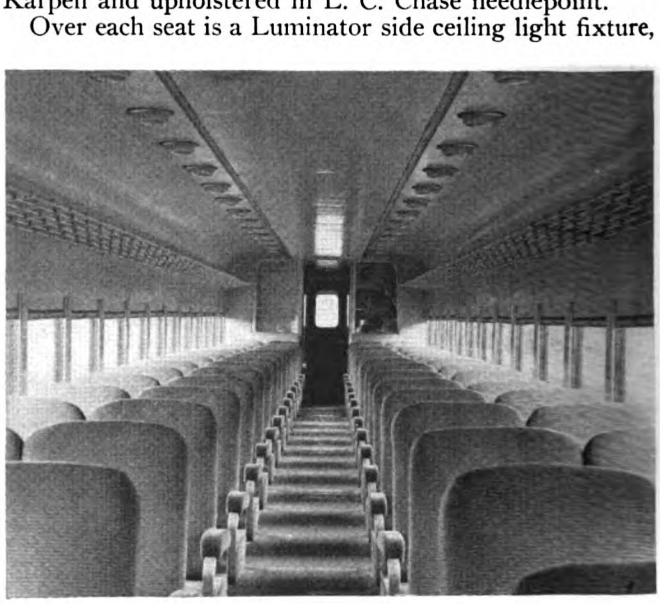
General Description

These rail cars were especially built for fast passenger service and secondary service on main lines and, therefore, the wide vestibules were equipped with swing doors and retractable steps to facilitate speedy loading and discharge of passengers. The steps, when locked in the closed position, carry a section of the skirting which covers the step well thus maintaining the streamline appearance on the exterior of the car.

O. M. Edwards Company's double-glazed dehydrated sash was used, the inner sash being made removable for cleaning purposes.

The seats are the reclining back type furnished by Karpen and upholstered in L. C. Chase needlepoint.

Over each seat is a Luminator side ceiling light fixture,

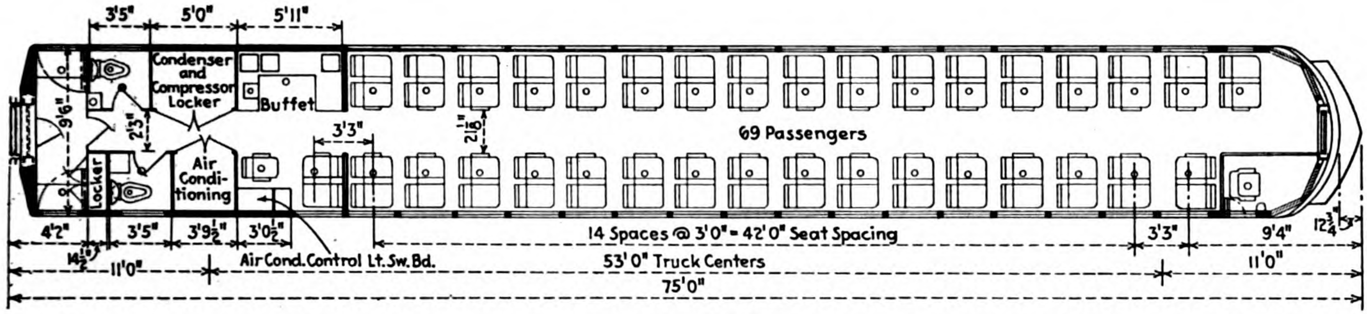


Full-length interior of the Illini

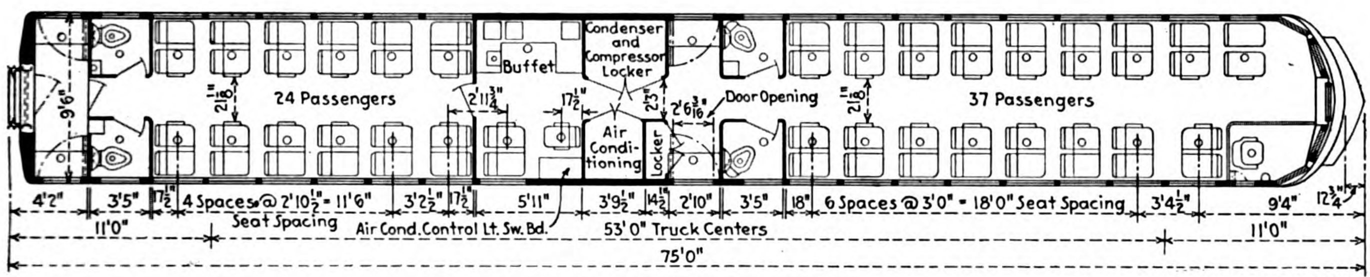
the lens of which is so made that there is an ample supply of light at the reading plane.

The cars are air-conditioned and heated with the American Car and Foundry Company's all-weather unit. The $6\frac{1}{2}$-ton capacity air-conditioning unit is so installed that the air is taken in through large grilles in the evaporator unit, is then blown through high-pressure ducts in the ceiling and thence through the low pressure Pyle National ducts for distribution to the interior of the car.

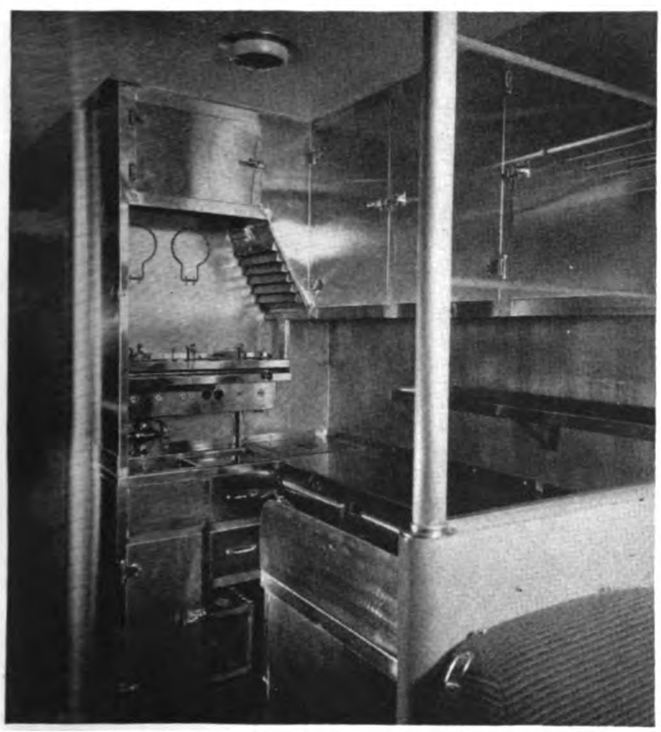
The heating is accomplished by reversing the air flow through the above-mentioned unit, the air being passed through fin coils which are heated by the hot water from



Floor plan of the "Illini," No. 130



Floor plan of the "Miss Lou," No. 131



The buffet in No. 130

the engine cooling system. The air is then blown downward and carried throughout the car in ducts located at each side of the car under the seats.

Supplementing the available heat from the hot water in the engine cooling system, and in order to give more flexibility in the thermostatic temperature control, a 12-kw. electrical heating unit was also added in the heating and cooling locker.

Interior and Exterior Decoration

The exteriors of the two cars are different as to color scheme only.

The Illini, which will go into service between Chicago and Champaign, is painted blue and orange incorporating the use of the University of Illinois colors. The navy blue being used on the lower girder and above the windows at the front end, the orange below the girder on the skirting and on the letterboard above the windows. The piers are gray simulating glass which render them less conspicuous. The roof is finished in an aluminum paint.

The Southern car, or Miss Lou, incorporates the colors of the Mississippi and Louisiana state universities, purple and gold, and blue and red, respectively.

The lower girder and the letterboard above the front windows is painted blue and the skirting and letterboard at the side is red. The purple and gold is used in the striping around the windows and the vertical piers are treated the same as the Illini.

The interior decorative schemes of both cars are alike and is built up around the two shades—blue and gray.

The wainscoting or dado, painted a strong blue, forms a perfect background for the seats, six of which at either end of the compartment are upholstered in a soft blue dual tone striped bonpoint material. Those in between are covered in the same type fabric in soft gray.

This arrangement of dark tone seats at opposite ends of the compartment gives the illusion of shortening it, thus taking away the long tunnel appearance usually seen in the standard passenger car.

The window capping is black, while the piers, facis and bulkheads are a light shade of blue gray.

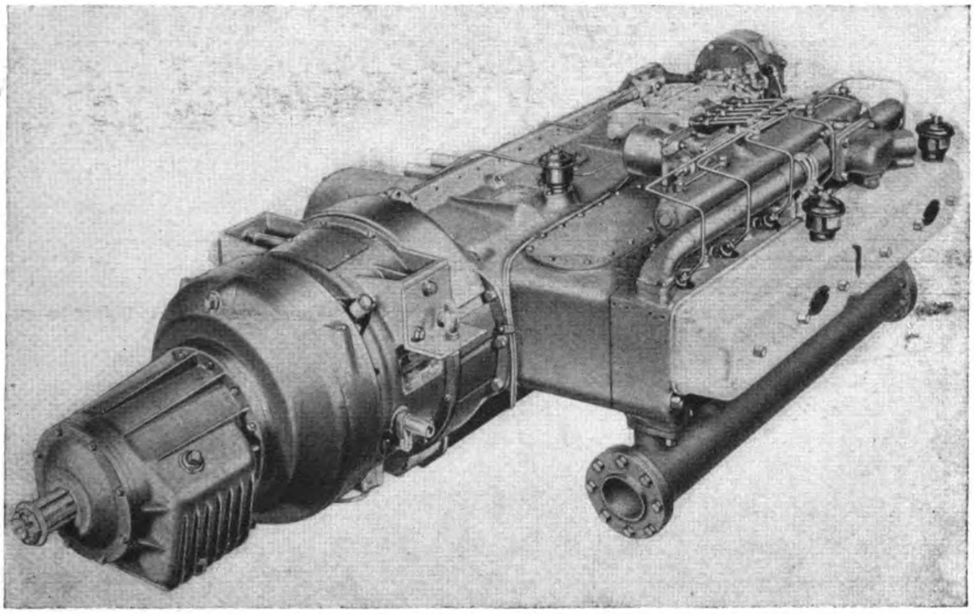
The Excel curtains are a gray faced Moonray material with an orange accent stripe across the bottom.

The side and center ceiling are egg shell ivory and are separated by two 16-in. bands of light gray which set off the side ceiling lights. The lights are finished in satin finished chrome in keeping with all of the hardware in the car. An orange stripe each side of the air duct introduces an interesting note of contrast.

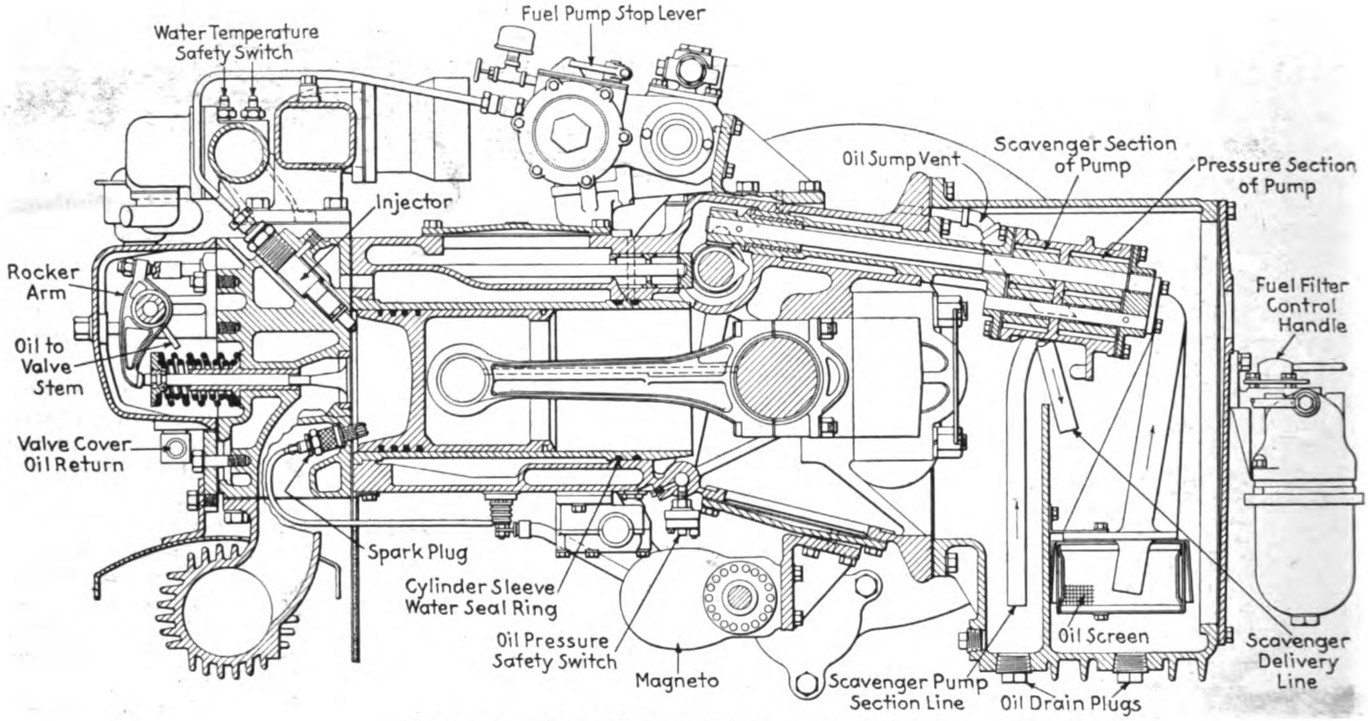
The basket racks, furnished by Adams and Westlake, are of tubular design and satin chrome finish.

The floor is covered with Armstrong taupe linoleum and has rectangular block inlaid decorations of blue and orange repeating at nine-foot increments throughout the aisle.

The cab at the forward end of the car is merely sur-



The power plants consist of two six-cylinder Waukesha-Hesselman 225 hp. oil engines with Twin Disc Clutch and torque converter and free-wheeling unit



Cross section of the Waukesha-Hesselman horizontal engine

rounded with a tubular railing thus leaving the entire front end open above the seat level for the clear vision of all passengers.

The bulkhead at the rear of the compartment appears to be a large arch. However, the door is framed on each side by large glass openings beyond which can be seen the stainless steel buffet. The buffet was furnished by Angelo Colonna and is compact, and efficiently designed for serving light lunches.

The Power Plant and Transmission

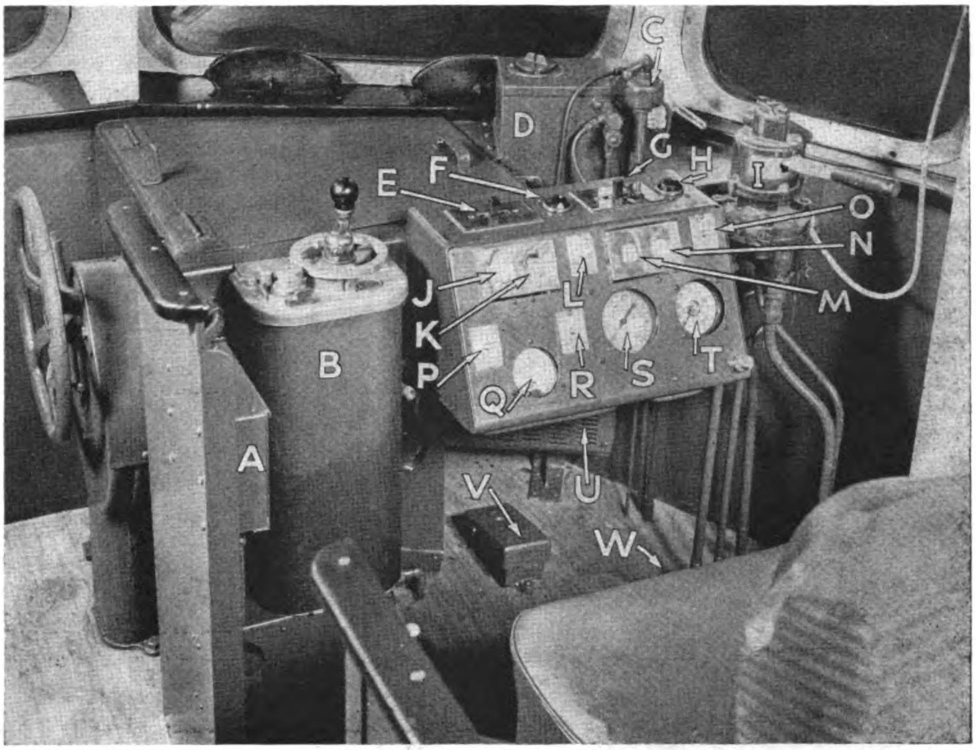
The six-cylinder engines for these cars burn Diesel oil, but are not Diesel engines. They are built for American Car and Foundry Company by the Waukesha Motor Company, Waukesha, Wis., under license of the Hesselman Motor Company, Stockholm, Sweden. Each engine is a solid injection, low-pressure, electric ignition oil engine.

In operation, the Hesselman engine, like the Diesel engine, draws in a charge of air alone, which is then compressed to a maximum compression pressure from 135 to 140 lb. per sq. in. Near the top of the compression stroke, the Bosch fuel pump injects a metered charge of fuel oil into the turbulent air stream where it is mixed thoroughly and is swept around the combustion space past the electrodes of the spark plug, which is on the opposite side. At this point, the spark plug fires the charge and the piston moves forward on the power stroke. Near the end of the power stroke, the exhaust valve opens, releases the burned gas and the cycle is repeated.

Each engine develops 225 hp. at 1,800 r. p. m. and will operate either independently or together from one control station, permitting flexibility in car performance as well as in the selection of the actual power applied. The engines are 6¼-in. bore by 6½-in. stroke.

The operator's control position

A—Torque converter fluid pressure gages
B—Master controller
C—Bell ringer valve
D—Torque converter fluid reserve tank
E—Heater switch
F—Warning light—rear engine 12-volt system
G—Headlight switch
H—Warning light-front engine 12-volt system
I—Brake valve
J—Cab light switch
K—Defroster switch
L—Priming fuel pump switch-front engine
M—Instrument board light switch
N—Classification and marker light switch
O—Starting motor switch—front engine
P—Priming fuel pump switch—rear engine
Q—Ammeter—125-volt system
R—Starting motor switch—rear engine
S—Air pressure gage
T—Speedometer
U—Cab heater
V—Sander pedal
W—"Deadman" pedal (not visible)



The engines are equipped with full safety devices, which protect them against overheating, loss of lubricant, low oil pressure or low cooling water supply. They are started by conventional electric starters, which is possible due to their low compression pressure and relative ease with which they may be cranked.

The transmission is a hydraulic torque converter which includes a direct drive feature. It is manufactured by the Twin Disc Clutch Company and is designed especially for rail motor car use. The torque converter consists of two elements: One, the hydraulic element which provides torque multiplication for acceleration and performance on heavy grades; the other, the direct drive element which couples the engine directly to the drive axle for operation at higher speeds and on lesser grades. There is a duplex clutch in the torque converter for the engagement of either the hydraulic or direct drive element. A free-wheeling device is used on the power take-off shaft to permit the car to drift freely without the retarding effect caused by engine drag when the engines are not driving the car. The free-wheeling device will also permit the operation of either engine if the other is inoperative. The duplex clutch is actuated electro-pneumatically. An electrically-controlled air cylinder shifts the clutch on both torque-converters simultaneously and has a neutal position when neither of the duplex clutches is engaged.

Car operation is controlled by a master controller which in the "off" position completely shuts off fuel oil from both engines. The first controller position allows the engine to idle at approximately 800 r. p. m. In the next seven positions, engine speed is increased and the car moves through the hydraulic drive to a maximum engine speed of 1,800 r. p. m. or approximately 45 m. p.h. car speed. Here the controller handle has a stop. When the stop is released and the handle moved to the next position, the engine speed drops to 800 r. p. m. and the shift from hydraulic to mechanical drive is made automatically by an electro-pneumatic cylinder on the Twin Disc torque converter. From this point there are nine controller positions in mechanical drive through which engine speed is increased to a maximum of 1,800 r. p. m. and a car speed of 73.5 m. p. h. The reverser handle on the controller is interlocked so that the main speed control handle can not be moved when the reverser handle is in the neutral position.

Forward and reverse operations are accomplished by shifting a sliding jaw clutch in each of the two drive axles. Each drive axle has two floating spiral bevel ring gears meshing with a common pinion. The jaw clutch is locked to the drive axle shaft by splines and engages one ring gear or the other depending on which direction the car is to operate. The forward and reverse shifts on the two drive axles are synchronized and actuated by an air cylinder controlled by an electric switch in the operator's cab. Both axles are shifted simultaneously.

All of the power and control equipment is located under the floor of the car. The hydraulic torque converter is bolted directly to the engine flywheel housing. Power is transmitted from the torque converter by means of a drive shaft toward each truck. The outer end of each drive shaft is retained by a midship bearing. From these points the power is transmitted by means of a propeller shaft having two solid universal joints to each drive axle. Each propeller shaft projects through a clearance hole in its respective truck bolster.

Accessories are driven by V-belts from a main sheave which is in turn driven by the propeller shaft from the timing gear end of each engine crankshaft. Half of the accessories are driven by each engine so that accessory power is divided equally between the two. The accessories for each engine consist of one 20-kw. 125-volt d.c. generator, one 12-volt generator, one engine cooling water pump, and one Bendix-Westinghouse 12 c. f. m. air compressor.

Each engine has two sections of water cooling radiators arranged across the car adjacent to the accessories and their belt drives. The radiator cores are of the fin and tube type. Engine water temperature is regulated by Kysor automatic thermostatically-controlled radiator shutters. These shutters are operated by a thermostatic air valve and an air operating cylinder and by means of felt inserts in the vane edges are tightly closed in the closed position. The thermostat tube is located in the water line between the engine outlet and the top of the

radiator. When the temperature of the engine cooling water reaches 188 deg., the shutters open and remain open until the temperature drops to 180 deg. at which point they close. Radiators are cooled by 26-in. diameter aluminum fans, one of which is driven by each engine. Each fan is driven by a propeller shaft having a flexible rubber joint at each end, and one end of which is attached to each main belt sheave. The engine cooling water also cools the torque converter fluid by means of heat exchangers. Car heat is obtained from engine cooling water which is supplemented by electric heat from one or both of the 20-kw. generators in cold weather. These generators supply current for air conditioning, etc., during summer operation.

Electrical Equipment

Electrical equipment on these cars is based on using a dual voltage system, i. e., 12 volts and 125 volts. The 12-volt system is used for engine starting, headlight, defroster, and other small accessories. Each headlight is equipped with a 12-volt 30-ampere bulb which gives a pickup distance considerably in excess of a conventional locomotive headlight. The 12-volt 25-plate battery is charged from a 40-ampere generator belt driven from the engine.

Each power plant belt drives a 125 volt, 20 kw. generator over a speed range of nearly 4 to 1. Cool, clean air for each generator is supplied through a louvred opening in the side of the car which has a suitable duct connection to the generator. Two generators on each car are operated in parallel through an equalizing resistor and supply the necessary power for air conditioning, electric heat, electric range, hot water, lights, control and other electrical accessories and at the same time charges a 56 cell KX-7H Exide Ironclad battery. The electrical control circuits are so arranged that the cars can be arranged for multi-unit operation when necessary.

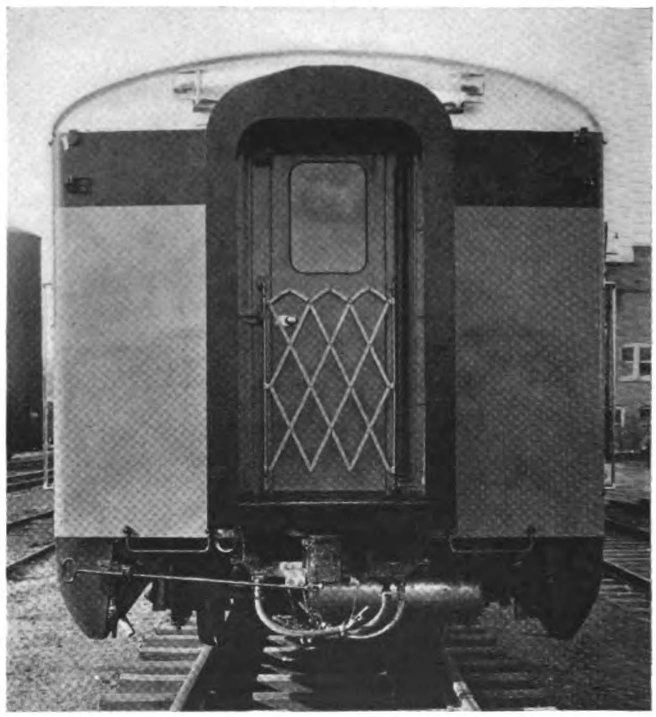
The power trucks have coil springs over the Timken roller-bearing journal boxes with the bolster supported on elliptic springs—The geared axle drive with shifting mechanism is in the foreground

Partial List of Materials and Equipment on the Illinois Central Rail Cars

Steels, low-alloy, high-tensile	Carnegie-Illinois Steel Corp., Pittsburgh, Pa.; Armco Railroad Sales Co., Middletown, Ohio.
Steel, open-hearth	Carnegie-Illinois Steel Corp., Pittsburgh, Pa.
Aluminum; step treads	Aluminum Co. of America, Pittsburgh, Pa.
Insulation	Johns-Manville Sales Corp., New York.
Couplers	McConway & Torley Co., Pittsburgh, Pa.
Roller bearings	The Timken Roller Bearing Company, Canton, Ohio.
Wheels; axles	Carnegie-Illinois Steel Corp., Pittsburgh, Pa.
Brake shoes	American Brake Shoe & Foundry Co., New York.
Springs	American Locomotive Co., Railway Steel Spring Div., New York.
Air compressor	Bendix-Westinghouse Automotive Air Brake Co., Pittsburgh, Pa.
Air brakes	New York Air Brake Co., New York.
Hand brake	National Brake Co., Buffalo, N. Y.
Engine	Waukesha Motor Co., Milwaukee, Wis.
Torque converted	Twin Disc Clutch Company, Racine, Wis.
Propeller shaft and bearing	Spicer Mfg. Co., Toledo, Ohio.
Generators	General Electric Company, Schenectady, N. Y.
Radiators	Young Radiator Co., Racine, Wis.
Radiator shutters	Kysor Heater Co., Cadillac, Mich.
Batteries	Electric Storage Battery Co., Philadelphia, Pa.
Exhaust ventilating fans	Diehl Mfg. Co., Elizabethport, N. J.
Multi-vent panel	The Pyle-National Company, Chicago.
Air-conditioning control	Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.
Cooling fans	B. F. Sturtevant Co., Hyde Park, Boston, Mass.
Air conditioning	American Car and Foundry Co., New York.
Headlights; charging receptacle	The Pyle-National Company, Chicago.
Light fixtures	Luminator, Inc., Chicago; Safety Car Heating & Lighting Co., New York.
Air sander	Graham-White Sander Corp., Roanoke, Va.
Cab heaters	Consolidated Car Heating Co., Albany, N. Y.
Sash	O. M. Edwards, Inc., Syracuse, N. Y.
Linoleum	Armstrong Cork Co., Lancaster, Pa.
Body seats	S. Karpen & Bros., Inc., Chicago.
Glass	Pittsburgh Plate Glass Co., Pittsburgh, Pa.
Window curtains and fixtures	Excel Curtain Co., Elkhart, Ind.
Locomotive bell and ringer	American Locomotive Co., Railway Steel Spring Div., New York.
Dual tone Leslie-Tyfons	Leslie Co., Lyndhurst, N. J.
Rear horn	Buell Mfg. Co., Chicago.
Basket racks	The Adams & Westlake Co., Elkhart, Ind.
Shock absorbers	Houde Engineering Corp., Buffalo, N. Y.

Trucks, Couplers and Brake Equipment

The trucks are the four-wheel type with cast-steel frames and bolsters. The axles are mounted in Timken roller bearings. The side frames are supported on the journal boxes by coil springs, and carry the bolster on full elliptic springs. The truck center plate is a new design, in which, by means of a Neoprene pad working partially in shear and in compression, isolates the car body from the truck. The trucks have inside brakes with cylinders mounted on the truck frames and are equipped with Hondaille shock absorbers to restrain both lateral and vertical motion.



The rear ends of these cars are designed and equipped for multiple-unit service

The air brake system is the New York Air Brake Company's Schedule SME straight air brake with automatic emergency feature designed to stop the cars at a braking rate of 2.5 m. p. h. per second at 75 lb. pressure.

The coupler at the front end is concealed within the sheathing and flush removable covers are used.

Steam Locomotives and

Train Acceleration*

By L. B. Jones†

A study of the relation between the cylinder tractive force of high-speed steam locomotives and the energy required to accelerate trains of differing weights at various rates

THE mathematics of the acceleration of railway vehicles has been fully discussed in various textbooks and also in previous papers presented before the society; but for convenience of ready reference the fundamental concepts are herein reviewed. The weights of locomotive and train are expressed in tons and acceleration is expressed in terms of miles per hour per minute or per mile, to conform with the customary statistics of train schedules, in distinction to the common formulas of physics and mechanics expressed in terms of pounds, feet, and seconds. By this means, it is hoped to record data which will be helpful to operating officers as well as to designing engineers. Because the energy of acceleration varies with the square of the velocity, but only directly with the weight of the train, simple arithmetical proportion is deficient when comparing different locomotives or different weights of trains at the higher speeds, and a graphic analysis is most useful to show what actually takes place.

The force available for acceleration in the cylinders of the ordinary two-cylinder steam locomotive is expressed by the well-known formula

$$T = \frac{C^2PS}{D}$$

where T = cylinder tractive force, lb.
C = mean diameter of the cylinders, in.
P = mean effective pressure, lb. per sq. in.
S = piston stroke, in.
D = diameter of drivers, in.

The formula contains three fixed dimensional values and only one value subject to variation with speed, i. e., the main effective pressure. It therefore follows that, as this value is maintained or increased, the cylinder tractive force will be maintained or increased; which is the only force, on level track, available to accelerate the train. Therefore, the ability of a steam locomotive to accelerate a train rests with its mean effective pressure.

In Figs. 1 and 2 are shown cylinder-horsepower and cylinder-tractive-force versus speed curves for several locomotives, in which curve A represents a Pacific-type locomotive which has been performing satisfactorily in main-line passenger service for several years. For the purpose of this study, curves B, C, D, and E represent successive improvements in the mean effective pressure of this same locomotive, but for simplification the studies of train acceleration are confined to the minimum or present locomotive A, and the maximum or improved locomotive E. The latter has been selected as the maximum locomotive for this study because, as shown in Fig. 1, the cylinder horsepower is maintained almost constant from 60 to 100 m.p.h. While it is sufficiently in advance of current steam-locomotive practice to be called a "maximum" locomotive, it is by no means an "ultimate" locomotive because, if the mean effective pressure could be still better maintained as the speed increases, the horsepower would actually increase with the speed above 60 m.p.h., as it now does below that speed.

If yet greater power must be obtained, a glance at the formula previously given will show that the only recourse is redesign, or the increase of one or more of the dimensional values. The advantages of improving the present locomotive, as compared with design changes, involving increased weight and capital investment, are illustrated by the curves in Figs. 4 to 8, inclusive, which have been developed on the assumption that improved locomotive E has been produced from present locomotive A without any increase in weight.

For this study, three trains weighing respectively 800, 1,000, and 1,200 tons behind the tender have been as-

* Abstract of paper contributed by the Railroad Division and presented at the annual meeting of The American Society of Mechanical Engineers in New York, December 2-6, 1940.

† Engineer of tests, Pennsylvania.

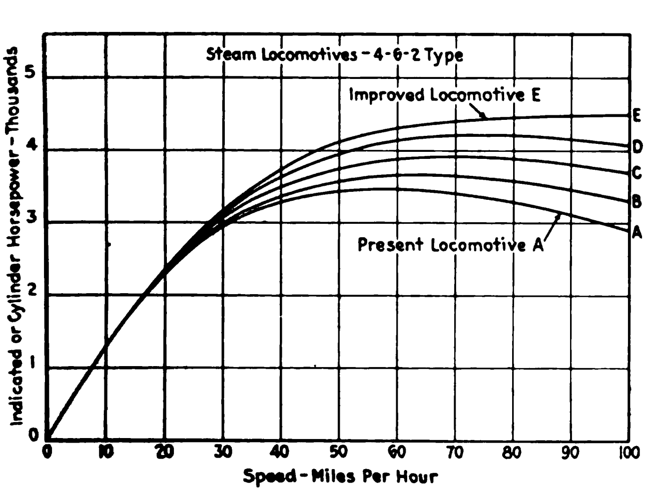


Fig. 1—Cylinder horsepower versus speed

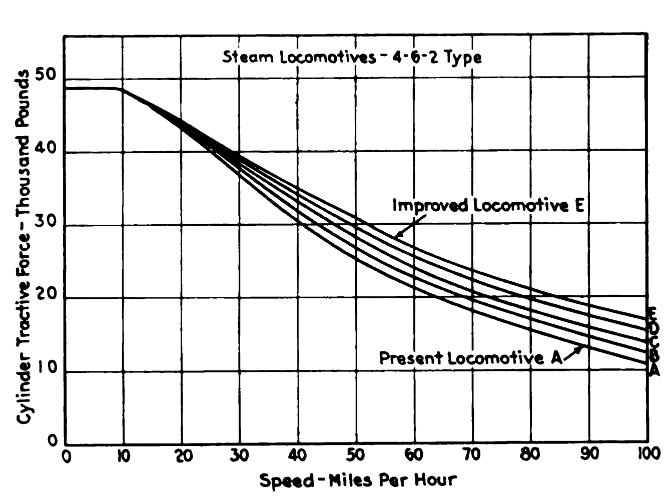


Fig. 2—Cylinder tractive force versus speed

sumed, and their gross resistances, based on the Davis formulas, are shown in Fig. 3. For simplicity, all calculations have been based on straight level track; the effect of grades, plus or minus, may be added or subtracted, and a similar correction may be made for curves. For purposes of comparing two or more locomotives, the assumption of level track will answer as well as any other condition which might be selected.

The curves involving speed, time, and distance were calculated from the tractive-force and resistance curves point by point and then verified by the mathematical formulas presented in the Appendix.* In each case, the two methods checked very closely; and it is evident that acceleration curves can be constructed by the formulas which will reflect the effect of changes in the tractive-force curve on the performance of the locomotive. Since the curves are plotted for the minimum and maximum locomotives only, it is also evident that the performance of the intermediate locomotives, *B*, *C*, and *D*, can be studied from the curves by interpolation. It will be noted that the mathematical studies in the Appendix follow closely the methods of Professor Barrow.†

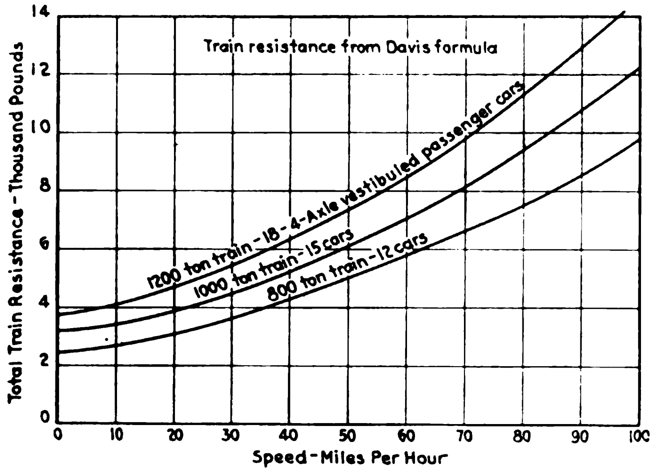


Fig. 3—Train resistance versus speed-level track

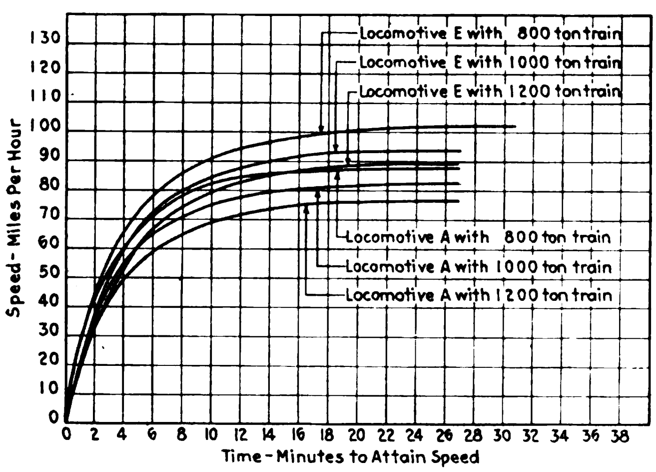


Fig. 4—Time versus speed

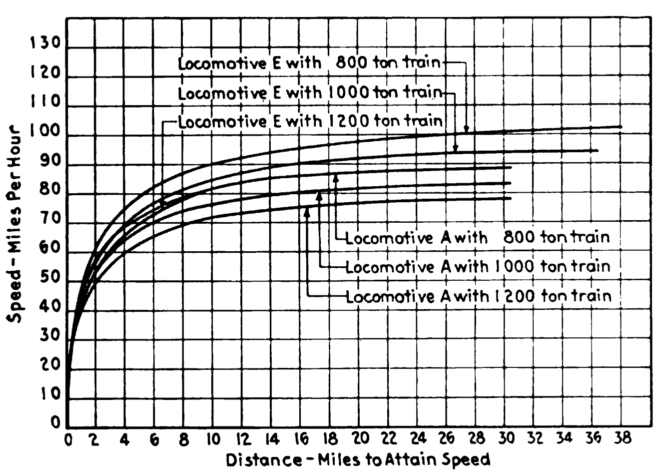


Fig. 5—Distance versus speed

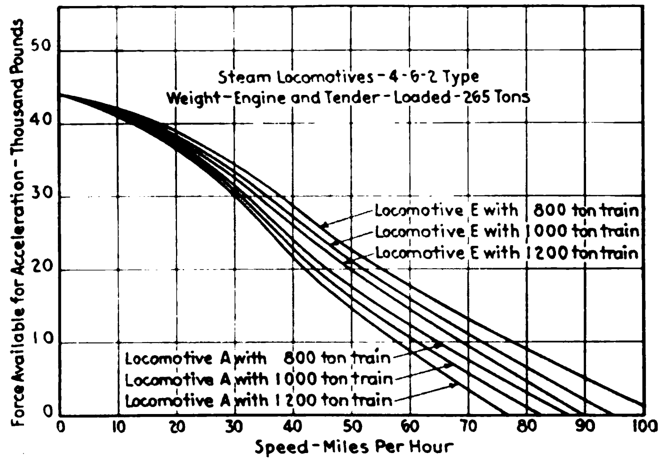


Fig. 6—Accelerating force versus speed

Fig. 4 compares present locomotive *A* with maximum locomotive *E*, hauling three different trains, and Fig. 5 illustrates the same comparison based on distance. It will be noted that the higher sustained horsepower of the improved locomotive results in a reduction of both time and distance required to attain a given speed.

Enforced Slowdowns—Effect on Train Operation

These curves also serve to emphasize a point which must be borne in mind by operating officers, and that is the serious handicap of enforced slowdowns. Locomotive *A* with an 800-ton train requires approximately 2½ min. or 1½ miles to attain 50 m.p.h., and 6½ additional min. or 7½ miles to attain 80 m.p.h.; so that, if the train is slowed from 80 to 50 m.p.h., 6½ min. or 7½ miles are required to resume the original speed. This should not be confused with elapsed time, which would include also time lost in slowing down and running at reduced speed, items not covered by this investigation.

Fig. 6 shows the force available for acceleration compared with speed. The locomotive has reached its maximum speed when the accelerating force becomes zero. To determine the maximum speed of the locomotives on a grade, it is only necessary to determine the grade resistance of the locomotive and train and draw a horizontal line at the corresponding value. The intersection of the curves with the line so drawn will show the maximum speed on the grade selected.

Fig. 7 shows a mathematical "race" between locomotives *A* and *E*. Starting from the same point, with trains of identical weight, it will be seen that, at the end

* The appendix included with this paper dealt with the equations for accelerating force and their applications. Ten cases were solved in accordance with the procedure given in detail in the appendix. They were for trains hauled by the present passenger locomotive *A* and the improved passenger locomotive *E* using 800-, 1,000- and 1,200-ton trains, a loaded 10-car passenger train made up of heavyweight cars and a loaded 10-car passenger train made up of lightweight cars.

† "Problems in Locomotive Acceleration," by A. C. Barrow, Civil Engineering, vol. 4, 1934, pp. 202-204.

of 12 min., locomotive E is 2 miles ahead of locomotive A; and the gap widens rapidly due to the more rapid acceleration of the improved locomotive.

Fig. 8 shows the effect of lightweight cars on the rate of acceleration. The weights of the two trains, with a given locomotive, are proportional to the time required to attain the same speed, and to the squares of the speeds attained in a given time. Therefore, it follows that, for a given maximum speed, the saving in schedule time by the lightweight train is confined to acceleration, and if there are no stops or speed reductions, the heavy train will require only a little more time to cover a given distance than the lightweight train. On the other hand, if there are numerous stops and slowdowns, the advantage of the lightweight train is multiplied.

Fig. 9 shows tractive-force curves for steam, electric, and Diesel locomotives of equivalent-nominal-horsepower rating. Steam locomotive E from previous studies is compared with assumed electric and Diesel locomotives, the continuous motor rating and the Diesel-engine rating being used for the electric and Diesel locomotives, respectively. It is common practice to take advantage of the overload capacity of electric motors while accelerating, which is a distinct advantage for an electric locomotive drawing its power from a trolley; but the Diesel is limited by the capacity of its engine, and the overload possibilities of the steam locomotive are circumscribed by considerations of economy and good practice, at least in the preparation of train schedules. A direct comparison of locomotives having such different characteristics is impossible, but the curves serve to illustrate the relative capacities for accelerating trains. They also demonstrate that the steam locomotive, with moderate improvement, is capable of taking rank with the best motive-power units.

Fig. 10 illustrates an advantage of the improved locomotive with respect to the power output required for acceleration to a given speed. The kinetic energy of two trains of the same weight is the same for any speed; but the improved locomotive requires less time and distance to attain speed and, therefore, the energy required to overcome friction is less. Inasmuch as each locomotive would have to cover the same distance in actual operation, this saving during acceleration is theoretical rather than real.

Design of Maximum Locomotive

Perhaps the greatest handicap of the steam locomotive is the deep-rooted conservatism of American locomotive designers which has sentenced it to be a machine of two cylinders controlled by one valve apiece. The destructive dynamic forces which diverge from the line of power transmission, and the ineffective steam distribution have, it seems, become necessary evils, to be tolerated rather than faced. The author believes that these handicaps can be overcome, while still retaining for the steam locomotive the simplicity and flexibility which are its greatest assets. The maximum locomotive E has been assumed as a two-cylinder locomotive, conventional in all respects but valve action; and it seems probable that no satisfactory arrangement of cylinders to eliminate counterbalances and dynamic augments can be developed until a

(*Continued on page 20*)

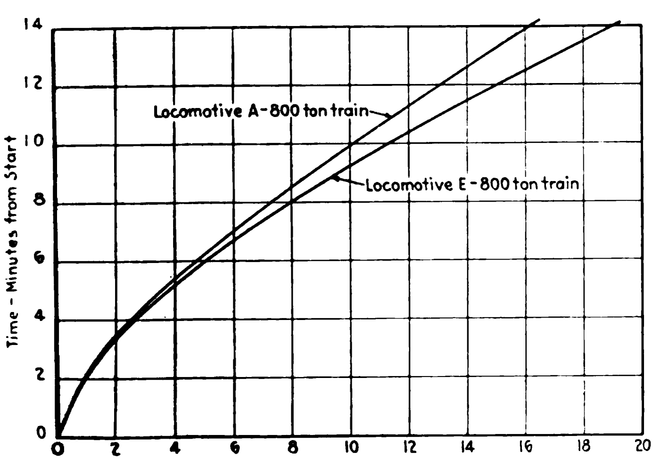


Fig. 7—Time versus distance

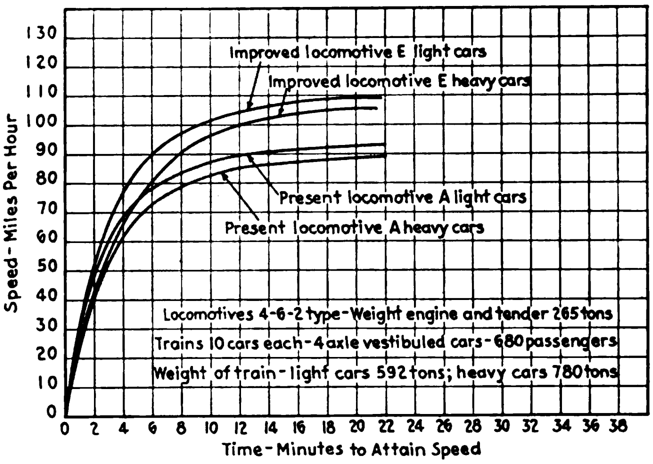


Fig. 8—Effect of car weight on the rate of acceleration

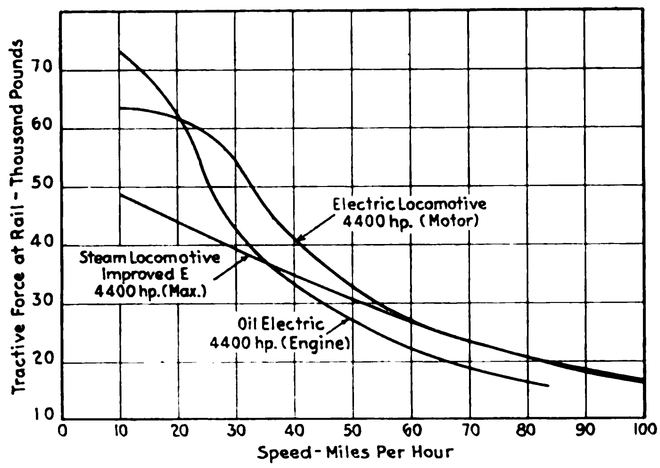


Fig. 9—Tractive force of various locomotives

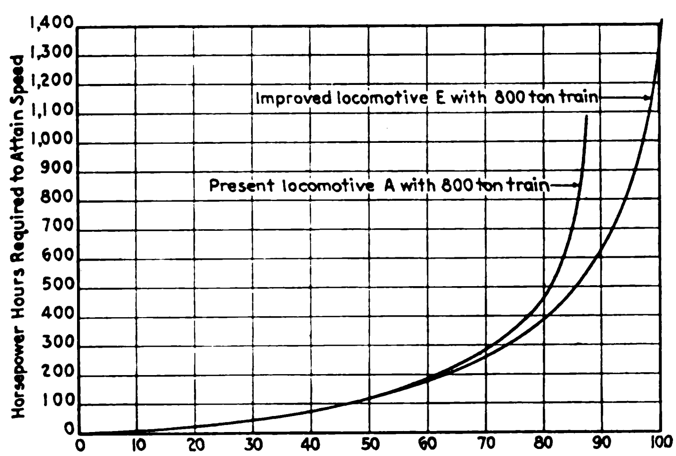
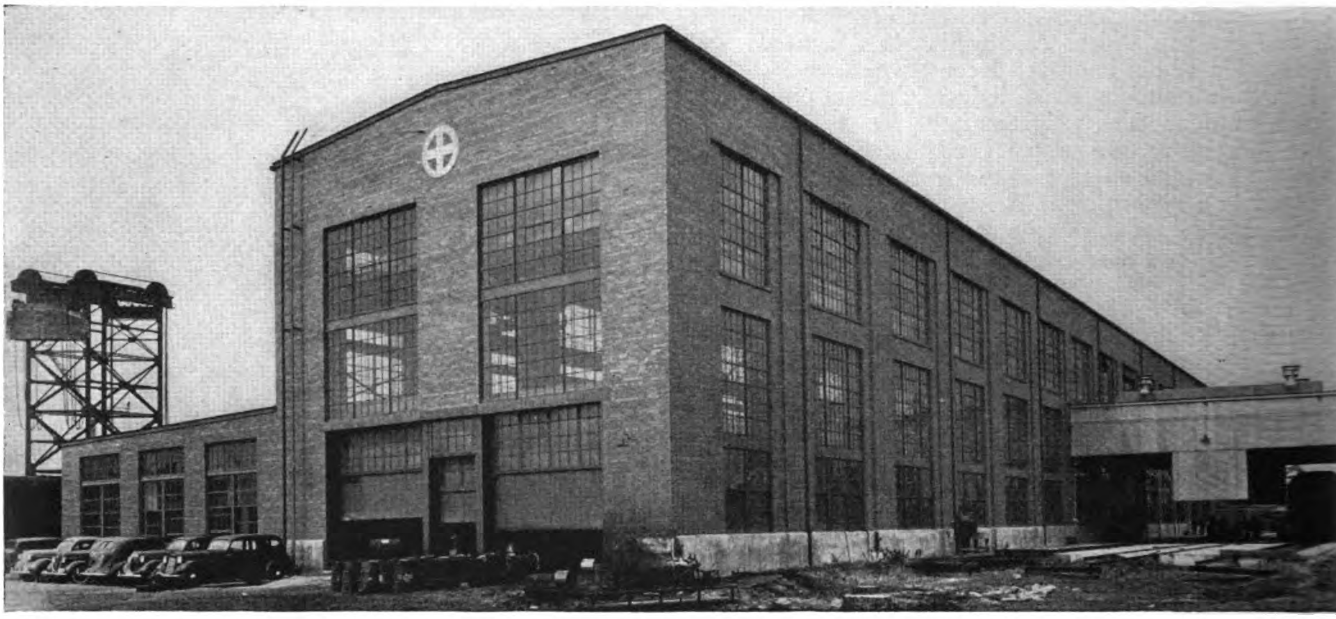


Fig. 10—Horsepower hours versus speed



The new Santa Fe Diesel locomotive shop at Chicago

Santa Fe

Diesel Locomotive Repair Shop

THE Atchison, Topeka & Santa Fe has recently put in service at its Chicago terminal a shop for the maintenance and repair work on Diesel locomotives which is believed to be the first shop of its kind to be constructed. The Chicago terminal was chosen as the location for this facility since the greater portion of the Diesel locomotives on the Santa Fe operate in through train service between Chicago and Los Angeles, Cal., and layover in Chicago. The Diesel locomotives not running into Chicago can be repaired in shops adjacent to their lay-over terminals. The nearest locomotive repair plant to Chicago is at Fort Madison, Ia., 232 miles distant, and therefore is not available for work on Diesel locomotives.

Heavy electric traction motors are handled with the 10-ton crane hook —A 260-ton Whiting hoist is used to lift and lower the locomotive

Diesel locomotives have been in both road and switch service on the Santa Fe for about five years and the design of this shop is based on the maintenance work that has been found necessary, and that which may be anticipated.

The principal repairs necessary are those in connection with the maintenance of cylinder liners, connecting rods, cylinder heads, valves, pistons, and connecting bearings; also, the replacing of worn wheels and traction motors and their bearings. Other routine maintenance work such as the changing of lubricating oil in crank cases and the cleaning of oil and air filters and similar work is performed in this shop.

The new Diesel shop has been built in connection with other extensive improvements in the Chicago terminal which has involved an addition to the enginehouse, a new power house, a modern coach cleaning yard and other terminal facilities. It was found more desirable and economical to separate Diesel repairs from steam locomotive repairs such as are usually carried on in enginehouses.

The Diesel shop building is of steel frame construction with brick walls and steel sash. Its length is 324 ft. 2 in. and width 111 ft. 6 in. It is comprised of two bays, a high bay or erecting bay having a width center to center of columns of 55 ft. and a height under roof truss of 41 ft. 6 in. The low bay or machine bay is 54 ft. wide and has a minimum height under roof girder of

Removing a Diesel-engine cylinder head

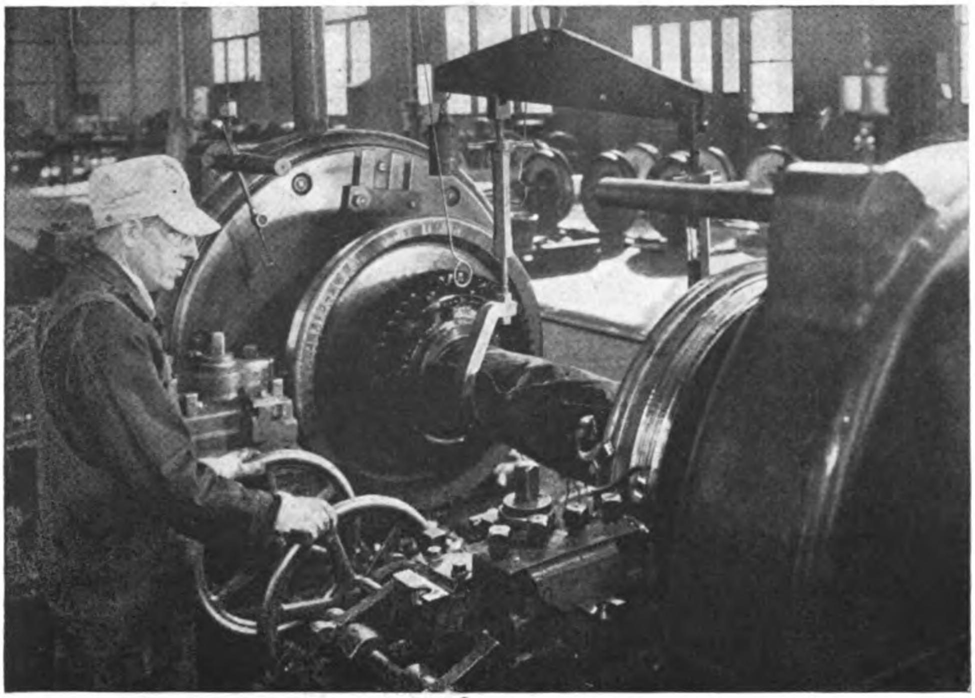
16 ft. A shed roof 69 ft. long and 48 ft. 10 in. wide is built onto the erecting bay over the coach drop pits on the side opposite to the machine bay. This shed is built in such a manner that it can be extended and enclosed to form another bay of the building.

Looking to the further expansion of this facility, footings for building columns have been poured in connection with an adjacent coach-yard building so that yet another bay can be added to the Diesel building and so that all bays can be increased in length about 50 per cent of their present length.

The building is well lighted by ample sash in the outer walls and by A-shape skylights. The floor is of concrete, surfaced with asphaltum blocks in the erecting bay and Kreolite blocks in the machine bay. Ample artificial lighting is made available by including recessed lights in the pits. The heating is by unit heaters.

Pulling out a Diesel engine piston

The erecting bay has two pits



A balanced wheel - lifting frame used at the wheel lathe—Axles are protected with canvas

Machinery in Santa Fe Diesel Locomotive Shop at Chicago

1—42-in. Sellers wheel lathe
1—United States Electric Tool Company 7½-hp. double grinder
1—Small combination buffer and grinder, 3 hp., 3-in. diameter wheels
1—Albright & Nell Company grindstone, 48-in. diameter wheel
1—Monarch 20-in. engine lathe
1—Cincinnati 36-in. heavy-duty shaper
1—No. 2 Kempsmith universal milling machine
1—Sensitive drill press (bench type)
1—Niles Tool Company 5-ft. right-line radial drill
1—American 24-in. engine lathe
1—Magnaflux testing machine, type BS-202
1—Hydraulic press, 3½-in. by 6-in. ram, 18 in. by 18 in. between frame
1—Steam generator safety-control testing device
1—Hobart 400-amp. electric welding machine
1—Autogenous welding and cutting outfit
1—Whiting automatic 6-ft. drop table
1—Whiting 260-ton lift hoist
1—P&H overhead traveling crane equipped with 40-ton and 10-ton hooks
7—Steel work benches equipped with vices, etc.
3—Crankshaft crank-throw grinders
1—Crankshaft main bearing grinder
1—Bacharach Premax piston pressure indicator
Wheel micrometers used in connection with wheel lathe work to keep wheel diameters within two to four thousands tolerance.
Supply of miscellaneous small tools, hand grinders, cylinder hones, micrometers, etc.

Two longitudinal repair tracks extending the length of the erecting bay are laid with concrete jacking blocks outside of rails. Between the rails is a pit approximately four feet deep. Over these repair tracks operates an electric traveling crane having a capacity of 10 tons on a high-speed hook, and 40 tons on the main hook. This is sufficient to lift Diesel engine cabs and the engines and generators or other equipment out of the cabs. The steel of the erecting bay is designed to accommodate an additional crane of the same capacity as the present one.

At the end of one repair pit in the erecting bay is located a Whiting combination coach and locomotive hoist. This hoist is of the four-column type and has a capacity of 260 tons and a variable longitudinal spacing of the lifting pads from 33 ft. to 80 ft. This hoist is of sufficient capacity and is arranged to lift any Diesel or steam locomotive or other piece of equipment which can be run into the Chicago terminal. It is expected that the hoist will be used principally for lifting Diesel locomotive bodies from their trucks, but it also can be employed for lifting locomotives and cars from their wheels. The use of the hoist obviates the necessity of a traveling crane of large capacity and the necessary heavy steel in the building to carry such a crane.

Under the other repair track in the erecting bay is placed a Whiting drop table in a pit. This pit also extends out under two tracks beneath the shed roof along side of the main building. This table is used for dropping wheels with motors from under Diesel locomotives in the erecting bay and for dropping coach wheels on the two tracks outside of the Diesel building.

At one end of the machine bay is located the wheel shop and some machine tools for heavy repair work. The electrical and air-conditioning repair shops are also in this bay and are separated by sash and wire screen enclosures. In one end of the machine bay are ample toilets and wash rooms with locker rooms. It is expected that the machine equipment will be supplemented from time to time as found necessary to meet the demands of repair work.

It is expected that these improved facilities will expedite repairs to Diesel locomotives, thereby increasing their availability and reducing maintenance cost.

Steam Locomotives and Train Acceleration

(Continued from page 17)

satisfactory valve action has been perfected. But regardless of the number and arrangement of the cylinders, the mean effective pressure will continue to govern the output; and the following additional assumptions have been made:

(*a*) Minimum pressure drop from boiler to steam chest. The superheater and pipes should afford free passage to the steam, for while steam which expands without doing work is raised in temperature, it is pressure which does the work in the cylinders.

(*b*) Adequate steam-chest volume. The opening of the admission valve results in equalization of pressures in the steam chest and cylinder; and at high speeds the surge of steam pressure from the pipes and header does not reach the steam chest until the valve has closed. The result is a maximum indicator-card pressure far below boiler pressure, and an average admission pressure yet lower. Meantime, the steam entering the chest at high

velocity builds up a surge pressure which may go 50 lb. above boiler pressure at its peak, but drops to normal before the next valve opening. An adequate steam-chest volume is, therefore, essential to hold up the admission line on the indicator card; and also to insure a uniform velocity of steam through the superheater and pipes.

(*c*) Well-designed exhaust passages. The ideal passage would pass the steam to the nozzle at maximum velocity and minimum back pressure; but since both are impossible of attainment in the same passage, a uniform cross section of smooth proportions is desirable. Too large an exhaust passage operates as an expansion chamber which has to be choked at the nozzle to produce draft, with resulting high back pressure against the piston in the center of its stroke, where it is most damaging to the mean effective pressure.

(*d*) Large exhaust nozzle, which is only possible with an efficient front end.

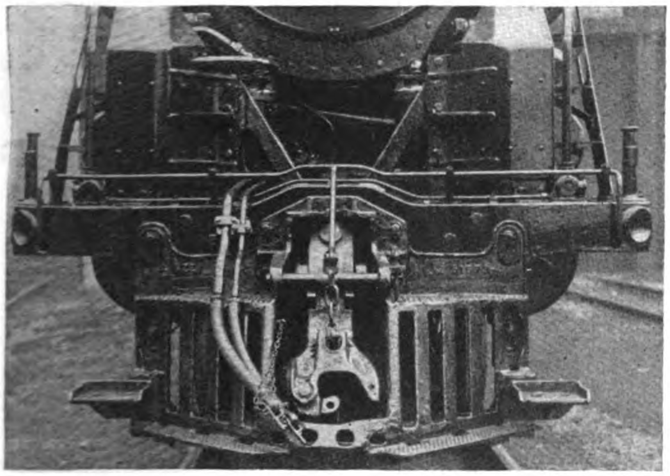
(*e*) Proper steam distribution. This specification eliminates the one-piece reciprocating valve, and requires separate admission and exhaust valves so arranged that cutoff may be shortened without advancing the other valve events. Various valve arrangements which meet this requirement more or less perfectly are extensively used in Europe and we would do well to profit by their experience. Experiments now under way in this country may lead to successful results.

New York Central 4-8-2 Type Locomotives

(*Continued from page 8*)

The tender is a 15,500 gal. riveted tank, with an unusually large coal space, welded to a Commonwealth cast-steel water-botton frame and supported on two six-wheel trucks. The frame and trucks were supplied by the General Steel Castings Corporation.

The trucks are equipped with 41-in. rolled-steel wheels, 6-in. by 12-in. journals and ASF clasp brakes. The brake



The front pilot and drop coupler arrangement on one of the locomotives equipped for passenger service

system is designed for 100 per cent braking with 50 lb. cylinder pressure based on a light tender weight of 158,600 lb.

The coal space has a capacity of 43 tons and is equipped with a modified Type D-A coal pusher. The stoker engine is housed inside the water space on the left side of the tender immediately back of the coal space.

The tenders of all the locomotives have water scoops.

Vertical Wheel Hand Brake

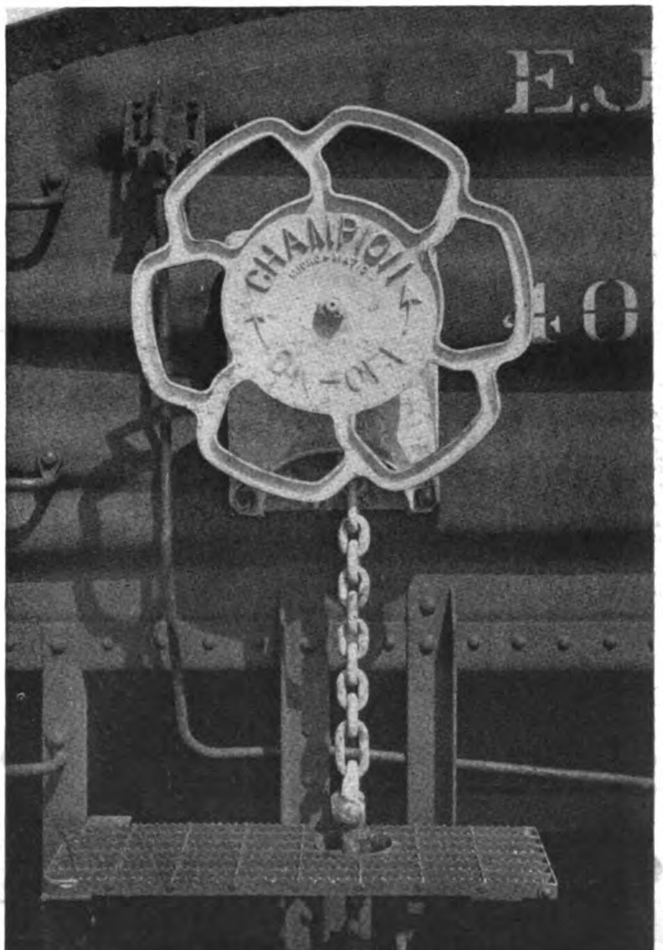
The Champion Brake Corporation has developed a vertical wheel hand brake, called the Micro-Matic safety hand brake, which is operated entirely by the hand wheel. It is being distributed by the Standard Car Sales Company, Inc., Chicago.

After being set, the brakeman effects a reduction in brake shoe pressure simply by turning the hand wheel in the reverse direction, thus reducing the braking effort as much as desired. Additional pressure on the brake shoes can again be secured at any time by turning the hand wheel in a clockwise direction, thus making sure that the brakeman will have accurate control of the braking effort at all times. The hand-wheel remains at whatever position it is turned to, regardless of the brake pressure applied, an important safety factor.

The brake is fast in action, requiring only two and one-half revolutions of the hand wheel to take up the slack and one-half revolution in addition to set the brake from full release position. There are no control levers to operate, eliminating any reason for the brakeman to let go his hold on the car, so this may be accurately referred to as a "one-hand" hand brake.

The brake is ruggedly constructed with relatively few parts, and is equipped like other Champion brakes which have been in service many years, with Oilite bearings having sealed-in-life-time lubrication.

The rim of the hand wheel has a hand grip designed to give a greater purchase for final application of power. It also provides a convenient grip for releasing the unit.



Champion Micro-Matic safety hand brake applied to hopper car

EDITORIALS

The 1940 Index

The index to the yearly issues of the *Railway Mechanical Engineer* is sent only to those subscribers who have asked that their names be placed on our permanent mailing list. Therefore, if you wish the index but have not been receiving it, please let us know promptly.

Plan for the Emergency!

From the beginning of our national defense program expressions of concern have been heard from many sources as to the ability of the railroads to meet the transportation demands imposed by it. Through the Association of American Railroads the nation has been reassured that the railways are ready to meet any demands which may be placed upon them, and, during 1940, every demand was met without visible car shortages. How about 1941?

The total volume of freight transportation for the year 1940 will probably equal, if not slightly exceed, that of 1937. At the present rate of progress the volume of production and transportation created by our defense program will continue to increase for some months and the total transportation volume for 1941 will undoubtedly be still higher than that for last year. But the present rate of progress, it is becoming increasingly evident, is not satisfactory and undoubtedly it will have to be speeded up.

So far, the defense program has been carefully regulated to interfere as little as possible with business as usual. Where possible, contracts for defense materials have been deferred to fill the valleys of normal peacetime production. This effort undoubtedly has influenced the demands on the railroads during the latter part of 1940. Indeed, it may be one of the causes accounting for the fact that in the neighborhood of 400 billion net ton-miles of freight traffic for the year was accompanied by an average carloading for the four highest weeks of 817,000, while for 1939, with 365 billion net ton-miles, the average carloadings for the four highest weeks was 844,000.

No attempt will be made here to estimate the total volume of traffic likely to be produced during the new year. It may be said, however, that an increase over 1940 of 10 per cent is entirely within the realm of probability. Depending upon the effectiveness with which the increasing transportation demands of the defense program are prevented from becoming major factors in the peaks, such a volume of traffic may effect an average carloading during the four highest weeks of the fall somewhere between 900,000 and 1,000,000 cars. If the present effort to arouse the nation to a war psychology in relation to its defense program proves effective, the peak demand may well be nearer the latter than the former figure.

Roughly translating these figures into car needs, it would appear that the railroads will need a minimum of 40,000 more freight cars by next fall than were available during 1940, and they might even need a far larger additional supply than that. It is doubtful, however, whether orders for more than 75,000 to 100,000 cars could be supplied within reasonable delivery dates during the new year—just how many will depend upon the extent to which the national defense program is accelerated.

No claim is made for extreme accuracy in these estimates. We believe, however, that they are sufficiently indicative of the situation now facing the railroads that each road should anticipate its requirements for new equipment, both cars and locomotives, with a considerably longer look ahead than usual and with liberal allowance for the possibility that the acuteness of the situation is going to increase rather than the reverse.

Refinement in Shop Methods Now Demanded

Accuracy of machine work and greater precision in the fitting and assembly of locomotive parts are factors of increasing importance in present-day maintenance work. One need only review many of the papers and discussions at the recent meetings of the mechanical associations at Chicago to realize that the operating conditions brought about by higher speeds and heavier loading are creating problems that can only be solved by a co-operative study of underlying factors and the relation of these factors each to the other.

A case in point is a problem that is giving several roads considerable trouble—that of assuring the proper alignment of locomotives as regards the related parts of frames and running gear. There have been instances where a single locomotive of the same type and class and in the same service in the same territory as several others, will come out of the shop after a complete general overhauling and develop mechanical difficulties necessitating expensive running repairs after a relatively short term of road service while the other locomotives in the same group will go through their assigned mileage without any unusual troubles.

What is the reason for such situations—is it a basic

fault in the design of parts, a question of the necessity for a change in shop methods to meet new conditions or, possibly, a changing set of operating conditions that is giving rise to troubles which have not previously been encountered?

In one shop the alignment of frame and running gear parts are checked individually and after assembly with precision gages. Wheel centers are mounted to gage and tires are set with micrometer gages in three positions 120 degrees apart on each pair of wheels so that the finished job is accurate to thousandths of an inch. The wheels are checked again in the tire turning lathe and after the turning is completed to assure that the plane through the center of the tread or flange is exactly at right angles to the centerline of the axle. All of this checking eliminates any possibility of an inaccurate pair of wheels reaching the erecting floor. Boxes and shoes and wedges are likewise checked before they go to the erecting floor and the same thorough pre-assembly checking is done on the parts and complete assembly of the engine and trailer trucks.

After assembly alignment is checked by lines parallel to the frames on both sides and gages are used to determine the distances to the front and rear diameter points at each wheel and a permanent record is made of all of the important actual dimensions of each locomotive as it leaves the shop.

The important facts that are being developed by the necessity of such precision methods are that better shop and enginehouse inspection methods must constantly be sought; that no tool or gage that will contribute to greater accuracy of machining or assembly can be looked upon as an unnecessary refinement and, most important of all, that the repeated requests of the shop officers for modern and more accurate machine tools and shop equipment must now be given serious consideration if these problems relating to longer-life locomotives are to be solved.

Car Supervisors' Hopes for 1941

What car supervisors (and locomotive supervisors also, for that matter) hope for primarily in the year 1941, is the development of enough traffic and railway earnings so that a reasonable budget of maintenance expenditures may be set up on a monthly basis and continued throughout the year without the wide fluctuations which are so demoralizing to shop forces and, by and large, tend to reduce the standard of equipment maintenance all out of proportion to the savings in payroll expense. Car supervisors, from the head of the department down, will ask no greater favor of 1941 than the ability to anticipate maintenance requirements and operate their respective departments on a basis which will supply an adequate number of cars of the many different types needed to meet the exacting demands of modern shippers and the traveling public, and supply these cars in condition to carry their respective loads to destination quickly and safely.

Car supervisors would, of course, like to have many other things in 1941 aside from uniform shop operation. Many of them would be downright appreciative of a sizable amount of new equipment to replace obsolete and worn out cars, thus reducing the average age of car inventories and enabling railroads to give improved service with less maintenance expense. New machine tools and equipment essential to efficient car-shop operation also are in the same category of a capital expense which would go far to increase the availability and earning capacity of railway car equipment and at the same time reduce unit maintenance costs.

Every car department head watches Account 314—Freight Train Car Repairs and Account 317—Passenger Train Car Repairs and many of them hope that they can keep the former under ¾ cents, and the latter under 2¾ cents a car-mile in 1941. Fervent prayers are being uttered for freedom from train delays and accidents due to equipment failures, particularly under the conditions of modern high-speed operation. Similarly, a favorable record in fewer personal injuries will gladden the hearts of the supervisors, many of whom will be well satisfied if the casualties, including minor injuries, can be reduced to three per million man-hours.

What wouldn't car surpervisors give for fewer hot boxes in 1941, even though present records show figures in some instances of 500,000 miles per hot box in freight service and 1,500,000 miles per hot box in passenger service? Even more than a reduction in the percentage of federal defects found by I. C. C. inspectors, car supervisors would consider it a boon if someone would tell them why their own inspectors cannot discover these defects before the government inspectors do. Car supervisors would like to see a smaller percentage of bad-order cars to revenue cars on line in 1941; reduced claim payments on account of defective equipment; and a smaller-car repair billing in favor of other roads.

Most of these things which car supervisors look forward to in 1941 are hardly in the nature of presents which will be handed to them on a platter. They are in much the same category as presents received by the head of a family at Christmas time from other members of the family who have no independent means of support. Father "pays the bill" and essentially gives the presents to himself. In other words, these highly desirable car-department goals and objectives, which car supervisors would like to see achieved in 1941, will never materialize except by the hard and faithful work of car supervisors, themselves. These men cannot expect to "make their dreams come true" except by intensive efforts in improving every detail of car-department operation and, particularly, instilling in car-department forces a real appreciation of the urgent need for increased efficiency in car maintenance and handling, so that shippers and passengers may be satisfied and railways enabled to expand their service with the attendant employment of more men in every department.

Mechanical Associations Frankly Challenged

The four mechanical associations that met in Chicago last October expected, when they adjourned, to assemble for four-day conventions without exhibits next September. As we understand it, they had already planned their programs on this basis. Since that time, however, it has been decided that only two-day conventions will be held.

Will so short a time suffice? We believe that with *proper planning* and with no time out to visit and study the exhibits, as much can probably be accomplished by most of the associations in two days as was done in four days last October. Obviously, with exhibits a longer period would be advisable. Why do we make this statement and why do we stress *"proper planning"?*

It seems to be more or less generally admitted that the most important and valuable part of these conventions is that devoted to the discussion of the papers. Such discussions ordinarily bring out much additional pertinent information. They also make it possible to establish contacts and friendships that can be followed up to advantage between conventions, when a fellow is facing an unusual problem and wants to know where to turn to compare experiences and find help in solving it.

Why not devote all of the time of the meetings to debate and discussion, thus covering practically as much ground in two days as in four days last year, in those conventions where advance papers were not made available to the membership? It means, of course, that all of the associations would have to preprint the reports and papers early enough so that they could be distributed to the members and be thoroughly digested before the conventions. In this way the time of presenting the report could be cut to, say, ten minutes, the chairman merely attempting to cover the high spots.

Distributing the reports in advance would have another distinct advantage. It is quite noticeable that in most instances the members find difficulty in following and digesting reports when they must depend entirely upon a single reading at the meeting. Much time is therefore lost in correcting misunderstandings and answering questions which would never have been propounded if the members had had time to read the reports carefully in advance. Some of the associations print the reports for the forthcoming meetings in advance, but to have all of them ready early enough so that copies may be placed in the hands of the members in time for study before the meetings, the officers and committee men will have to get extremely busy and do a real job during the next few months.

The Locomotive Maintenance Officers' Association will publish proceedings of the last convention, so that now all four of the associations have published proceedings. This should simplify the problem of printing advance copies of the reports, since in all events the type will have to be set, and little extra cost is involved, except for the paper, printing and mailing charges for the advance copies. These need not necessarily be bound in pamphlet form, as is true in the case of the Master Boiler Makers' Association, but can be sent out in galley form, as has been the custom of the Railway Fuel and Traveling Engineers' Association. It will, however, involve some additional expense. It is quite possible, however, that it can be used as an incentive in building up the membership and interest in the work of the associations.

It will not be an easy matter to get out the reports to the members well in advance of the conventions—nothing really worth while is easy! It can be done, however, if the officers of the associations keep in close touch with the committees and have submitted to them monthly resports of the progress that is being made.

The argument has also been advanced that it would be impossible to present the reports at the meeting in abstract, because not all of those present will have had access to advance copies of the reports and so will not be familiar with them. Why not? Men will hardly attend these meetings without having an invitation or having had advance information about the meeting. Certainly it ought to be possible to bear down hard on this point and see that ample publicity is given to the fact that the papers will be available in advance and must be digested before the members go to the convention. That it is possible to conduct meetings in this way has been proven time and time again by the experience of other organizations.

With only two-day meetings it will hardly be advisable to have general addresses, unless possibly a dinner meeting of the co-ordinated associations could be held on the night of the first day of the conventions. In some instances it may be advisable to have individual technical addresses, in which case, however, these should be prepared and distributed in advance. The speaker could make a brief five or ten-minute presentation of the high spots in the address, and the time ordinarily taken to giving the entire talk could be utilized for open forum purposes, thus helping to develop more clearly and amplify the points made in the printed address.

Obviously the cutting down of the time of the meetings presents a real challenge to the associations. It may, however, prove to be a blessing in disguise if it will force an intensive study of exactly how the conventions should be conducted in order to make the best possible use of every moment of time, and thus insure a maximum practical return from the investment of time and money that is made in these meetings.

Suggestions from those who attended the meetings last October will be found on the next page.

Suggestions for Mechanical Associations

Publicity Between Conventions

I would suggest that in the future you allot some space each month, say a page or less, to these associations to give news and include short comments from the secretaries or individual members as to the activities of the various organizations.

Advance Copies of Reports

Copies of the committee reports should be made up far enough in advance and forwarded to all members of the association, in order that we may digest the recommendations. While it is true we all received a great deal of benefit by receiving the reports at the meetings and having an opportunity to go over them as they were read on the floor, we did not have time enough to analyze them thoroughly and thus insure a profitable discussion.

Use of the "Mike"

While it is desirable, I am not sold on the idea that all of the discussion should be carried on through a "mike." I rather feel that you will lose some discussion for the reason that some will not care to come to the platform. The "mike" is an advantage to a speaker, but if he will take the time to weigh his remarks and speak clearly and slowly, I don't think generally the speaker will have much difficulty in making himself heard.

Concerning the Value of the Meetings

I am very strongly in favor of such mechanical meetings and I think it would be beneficial for the railroads to send supervising officers, including promising junior employees and roundhouse and assistant roundhouse foremen, as well as inspectors, to such meetings, *with instructions, of course, that they must render a report to their superior officer on returning to their headquarters.* I, of course, agree that a certain amount of entertainment is not harmful, but that the employees who are designated by the railroads to attend the meetings, and whose expenses are paid, should be required to attend and, if possible, take part in the discussion of the various papers read. I also think it would be helpful if an invitation was extended to the engineers and firemen and shop employees to attend one or more of the sessions if they desire—at their own expense, of course—as it has been my experience that most of the papers are very helpful; however, a good lively discussion from the floor usually has the effect of bringing out more information than is sometimes contained in the papers.

Larger Participation in Discussions?

Of the several hundred men attending the convention, probably every one had some particular problem on which he needed help. Quite probably there were men sitting in the audience who could supply the answers to these problems, provided the questions were asked. The average member seems to be fearful of going to the rostrum and using the microphone. You may have noted that in the average convention of from 300 to 400 men, not more than from 15 to 25 ever take part in the discussion of the papers and reports. It was suggested at our last convention that the timid ones write out their questions and send them to the platform. The chairman could then pass them on to the author when he had finished the presentation of his paper. Even this device failed miserably in securing the expected results. If you can suggest in your columns some way of overcoming this weakness it will help greatly to promote a healthy exchange of progressive ideas. Moreover, the association and the railroads will profit greatly thereby.

Wants Air Brake Association Back

While attending the conventions of the Air Brake Association and listening to the various papers presented, as well as the interesting discussion of these papers by such members as Clegg, Burton and many others, my understanding of air brake and train handling was greatly benefited. I know of no other way of securing information and hearing discussions on subjects such as above mentioned other than at the Air Brake Association. It is my earnest hope that this association can be revived for the benefit of all those interested in the air brake and train handling subject. More than ever it is my belief that the Air Brake Association should be revived because of the tremendous changes in air brake devices and train handling within the past few years. I am a member of the Locomotive Maintenance Officers' Association; however, I cannot see where I can be benefited enough by the attendance and listening to perhaps one paper on this subject that I am interested in; likewise with the Railway Fuel and Traveling Engineers' Association. At the recent convention only a half day was set aside for air brakes and train handling and naturally these papers must be limited to the understanding of the members of this association and cannot be presented with the necessary details to interest me.

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Comments from readers on suggestions made in our November, 1940, number for making more effective the efforts of the Mechanical Department Associations.

Associations Should Have Publicity Directors

In my opinion each of these associations needs some means for developing a more cohesive status in the interval between annual meetings. Under present conditions, with the exception of the officers and those appointed to committees for some specific service, as for the preparation of reports or papers for the annual meetings, the membership as a whole does not function and becomes aware of what has transpired during the previous twelve-month interval only by attendance at the annual meetings.

Although the national scope of an association prevents the membership from having the personal monthly contact enjoyed by the railway clubs in the various sections of the country, it appears that a valuable measure of monthly contact can be obtained by systematic use of your magazines, which are universally read by all concerned.

In view of this I suggest that each of the associations appoint a "publicity director," whose duty it will be to arrange monthly for the preparation and publication of material in the *Railway Mechanical Engineer*, pertinent to the work of the association. Comments would be invited from the association membership and from other interested railway employees. In my opinion, such a procedure would go a long way toward making each member conscious of membership in a live organization, as well as promoting the prime purpose of the associations, which is the mutual exchange of helpful information assembled by study, experiment and actual practice. Inasmuch as the latter constitute a continuous process, it is reasonable to expect that each organization will have no difficulty in selecting an interesting and worthwhile subject for release each month.

I feel certain that the officers and membership of the four associations recognize the need of closer relationship throughout the year and will be grateful for your assistance in promoting their work.

THE READER'S PAGE

Master Boiler Makers' Accomplishments

To the Editor:

You ask how the recommendations of the Master Boiler Makers' Association can be made more effective or, in other words, how the ideas as developed at their meetings can be made to "work."

The Master Boiler Makers' Association is not a legislative body and has no executive power to enforce its findings. From personal observation, however, during close to thirty years' affiliation, their findings and recommendations are effective to a greater degree than is generally known. Through the initiative of members and friends recommended practices are adopted, slowly perhaps but none the less surely. One by one as the best practices are selected from among others, they are accepted and put in force without fanfare or notice other than by the parties directly involved.

Because the association is without mandatory power it does not follow that the ideas developed are unheeded by the boilermaking industry. Their "gospel" is gradually accepted by the industry throughout the United States and frequently in foreign countries as well. Scores of instances could be cited where practices were adopted and good dollars saved as a direct result of the activities and recommendations of the Master Boiler Makers' Association. The book of records extending back over the past fifteen or twenty years will reveal many such. Moreover many of their recommendations are included in the federal law. The favor with which the Bureau of Locomotive Inspection views the deliberations of the Master Boiler Makers' Association has been common knowledge these several years and accounts in large measure for the adoption and enforcement of their findings.

Again, once it is demonstrated and proven that a given practice is superior to an existing or proposed practice, every forward-looking boiler supervisor wishes to benefit by the improved method.

Among the practices recommended and generally adopted are the following:

Normalizing of fire-box flanged steel to remove the stresses of flanging. It was demonstrated conclusively that normalizing more than doubled the life of flanged parts, including also back heads, front flue sheets and outside throat sheets.

Thickness of flue sheets is another matter generally influenced as a result of an exhaustive study by the Master Boiler Makers' Association. Prior to that study it was universally held that sheets of ½-in., 9/16-in. or ⅝-in. material were adequate for this service. The Master Boiler Makers' committee demonstrated that ¾-in. and even heavier was preferable, especially for the front head.

The use of flat head taper driven radials was developed on many roads as a direct result of the findings and recommendations of the Master Boiler Makers' Association.

Welding methods have improved and expanded as a result of members pooling their ideas and findings.

Throughout the years I personally have echoed one note of caution that can properly be included here. Members should guard against over-enthusiasm and a tendency to lend endorsement to a development before its merits have been demonstrated beyond reasonable doubt and over a safe and sufficient length of time. Observing this practice the Master Boiler Makers' Association has attained a reputation for accuracy, freedom from exaggeration and a devotion to truth. Methods and practices in an experimental stage have and should be acknowledged as such. It is in this way that we have advanced the prestige of the association and our own qualifications as real master boilermakers.

Wm. N. Moore,
Past-President, Master Boiler Makers' Assn., and General Boiler Foreman, Pere Marquette Railway Company.

North American Brake Association

To the Editor:

The Fifth Annual Air Brake Repairmen's Conference was recently held at Parsons, Kans. Those attending were air brake repairmen, air brake supervisors, traveling engineers and enginemen. The purpose of the conference was to bring forth the best methods developed for better maintenance of air brakes, which is reflected in better and more expeditious train handling.

The morning sessions were given over to discussions held in the M-K-T assembly room. The afternoon sessions were held in the M-K-T air brake shop, observing and demonstrating the actual detail repairs to various air brake devices. For example, the detail procedure of finishing the slide valve face and seat face to a "super" finish, having the minimum possible frictional resistance. Those attending this conference, including 106 men from roads other than the M-K-T, were given the opportunity to study, in detail, the methods and procedure followed in making repairs to all air brake devices in service on the M-K-T.

The evening sessions were held in the M-K-T assembly room and were devoted to train handling, bringing out methods of controlling freight train slack by brake and throttle operations which do not materially affect the speed of the train, yet prevent shocks, in sags and on curves, thereby materially reducing damage to lading and equipment.

At the conclusion of this four-day conference, it was the consensus of opinion that a brake association should be formed to perpetuate the good work of these conferences with meetings to be held on railroad property at different shop points. To accomplish this, an association was formed and given the name "North American Brake Association." The purpose of this organization is to insure that detail information will always be available to mechanics and enginemen and will not be lost sight of.

It has been decided to hold the first annual meeting on the Frisco Railroad in Springfield, Mo., utilizing its assembly room and shop facilities in the same manner as was done on the M-K-T. The attendance and interest shown at the Parsons meeting clearly demonstrates the men are eager for an association of this kind.

W. E. Vergan,
Denison, Tex.

Developments in

Flame Cutting of Metals*

New applications of the oxy-acetylene cutting process and the effect of the cutting on the severed metal parts

One of the most noticeable developments in the railroad shops, and in industrial shops as well, is the increasing use of flame-cutting machines. The advantages of mechanically holding, guiding and advancing the torch or blowpipe over the work being cut are rapidly becoming recognized and both stationary and portable cutting machines are coming into increased use in the shops for a wide variety of shape-cutting operations. These machines are capable of making flame cuts with jigsaw flexibility and yet of such high quality and accuracy that they ordinarily require no further finishing. Several types of flame-cutting machines have been developed that are capable of producing cuts of extreme accuracy with their travel guided by templates so that they may be considered practically automatic.

Multiple Cuts

Stationary flame-cutting machines have been developed that are equipped with more than one torch or blowpipe so that two or more parts may be cut at the same time from a centrally controlled or guiding source. Such machines have, in fact, been designed for use with as many as six cutting torches or blowpipes so that any number of identical shapes up to six may be cut simultaneously side by side. In addition, stack cutting has been worked out so that a cutting machine can shape parts from several superimposed plates at the same time. It is now difficult to conceive of any cutting or shaping operation on any ferrous material part that cannot be advantageously and economically cut by the oxy-acetylene process.

The success of stack cutting for the production of duplicate shapes and sections is dependent upon the thorough cleaning of the sheets or plates prior to stacking and the application of clamping or sufficient pressure to hold them together in rigid contact during the cutting operation. The sheets or plates must be cleaned of dirt, mill scale, rust, paint, etc., so that the clamping force can reduce the spacing between the stack plates to a very small amount. For this work C-clamps are generally used of such size and shape as to distribute the clamping pressure uniformly along the line of the cut. In some cases, it is necessary to run a series of welding beads across the edges of the stacked plates and this method is particularly satisfactory when the cut proceeds close to the edges of the plates. With plates properly stacked there is no practical limit to the number that may be cut in one operation, other than considerations of handling, clamping and cutting ranges of the equipment employed. In some instances the use of a top "waster" plate is recommended which can be a piece of scrap material, usually 3/16 in. or 1/4 in. in thickness. This tends to facilitate the cutting of stacks of thin sheets or of work where the cut doubles back on itself and tends to cause overheating at the point of crossing.

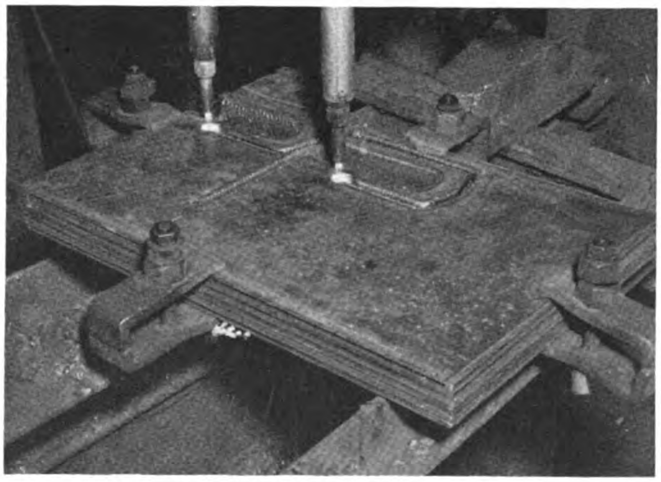
There is another important application of flame cutting which is in reality a form of flame machining that has been used for the preparation of plate edges either for caulking or for welding operations. Beveled flame cuts can be made as easily as square cuts by either inclining the tip or by using an angular tip. Grooved-plate-edge preparations are also being accomplished with special nozzles. Such finished cuts are usually made by machine, although for irregular edges hand cutting is often used.

Flame-Cut Holes

The use of flame cutting for drilling or piercing holes through plate or cast members is also being increased as the facility of this method becomes better understood. Probably every one is familiar with the use of the oxygen lance for projecting deep holes through thick billets or castings, but few have realized how this same method can be utilized for the production of straight-sided accurate holes if the nozzle or cutting tip is held rigidly during the piercing operation. For large holes, machine flame cutting can be utilized to perform cuts that are accurate in size and so smooth in contour as to usually not require any subsequent finishing operation.

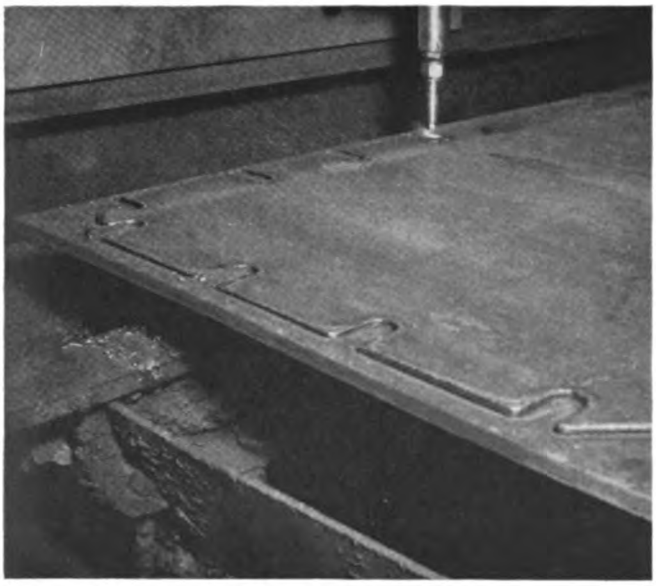
Flame Gouging

Flame gouging is a new method of using flame cutting for the forming of grooves in the surface of steel plates and forged parts. It is accomplished by using a cutting nozzle designed to deliver a relatively large jet of oxygen at low velocity which is directed and manipulated in such a manner that a smooth accurately defined groove is cut into the surface of the metal. By the use of different nozzles and manipulations, the depth and width of such a groove can be varied over a wide range.



Retaining plates for brake rigging are made by the piled-plate cutting of eight 1/4-in. plates—This operation is usually performed by single blowpipe cutting of piled plates

* Abstract of report presented at the annual meeting of the Master Boiler Makers' Association, October 22-25, 1940, at Chicago by a committee of the International Acetylene Association. This committee was composed of C. W. Obert, chairman, and J. H. Zimmerman, Linde Air Products Co., New York; F. C. Hasse, The Oxweld Railroad Service Co., Chicago; R. F. Helmkamp and A. N. Kugler, Air Reduction Sales Co., New York, and E. A. Randall, Compressed Industrial Gases, Inc., Chicago.



This casing cover plate for a superheater header shape is being cut with a single blowpipe from ½-in. plate—Note the jigsaw flexibility of the cut

Applications of flame gouging extend to such operations as the removing of temporary welds, the cutting of defects out of welded seams, gouging out the root of welded seams, gouging out the root of welded joints for welding in on the reverse side, and other details of plate-edge preparation. It is coming to play a large and effective part in the application of welded repairs and it is applicable for most of the ordinary low-carbon steels that are used in plate and structural work.

An interesting modification of this operation is that known as spot gouging which involves the piercing of a shallow circular depression in the surface of a plate or forging. By proper manipulation, such a spot may be cut very shallow or as deep as may be desired. The nozzle should be held so that the inner cones of the preheat flames are very close to the plate surface at all times during the cut.

Cutting Tolerances

One of the questions that is occasionally raised concerning flame-cutting operations as above outlined is that it is difficult to find such cuts down to close tolerances unless the torch or blowpipe is machine operated. This is, of course, correct as the trueness of the cut is dependent mainly on the steadiness with which the cutting tip is moved along or through the material. It is impossible to expect the same degree of accuracy in a hand-guided cut as would be obtained with a machine guided cut. Those unfamiliar with flame cutting find it difficult to believe that machine-guided cuts can be performed so accurately as to keep within the tolerances of 10 or 15 thousandths of an inch in cross section.

Warping and Buckling

An objection to flame cutting sometimes heard is that plates cut or trimmed along one edge tend to warp and buckle during the cutting operation. Such warping and buckling is, of course, possible under certain conditions if the plate or part requires a heavy cut and is not held rigidly in line by clamping it to a floor plate or other rigid member that will resist expansion and contraction movements of the material. If the plate or part cannot be held rigidly during the cutting operation, the effect of expansion and contraction can be nullified almost completely by making two or more cuts simultaneously or in rapid succession about the neutral axis of the member. This tends to equalize the forces set up and to neutralize their effect.

Plates under ⅜ in. or over ¾ in. in thickness are seldom warped or buckled perceptibly by flame cutting unless they are long and narrow. For splitting long narrow plates or pieces the so-called method of "skip-cutting" is occasionally employed. In this application the cut is made to skip at intervals depending largely on the character of the work, which leaves a series of uncut sections along the line of the cut edge about one inch long. These uncut ligaments hold the material in line until cooled, whereupon they are cut through to separate the cuts. Quenching the cut progressively also has been used effectively on long narrow sections. The same effect can be gained by making several simultaneous cuts with two or more torches or blowpipes, which are moved together along parallel lines. Where unusual accuracy is demanded in the dimensions of flame-cut parts, correction factors must be applied in making the cutting layout, particularly if the plate or part is preheated.

Rivet Cutting

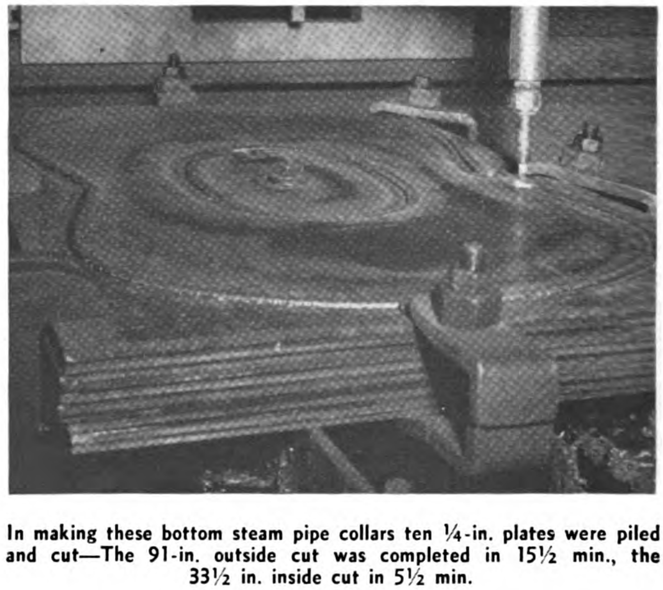
The increasing use of the cutting torch or blowpipe for removing rivets from boiler and car joints or seams is eloquent testimony to the fact that the safety and economy of this operation are becoming appreciated. For this, special cutting tips are used which have large cutting oxygen orifices of the expanding low-pressure, low-velocity type, together with high-intensity preheating flames that cause rapid surface oxidation of the heads of the rivets.

The application of the flame cutting of staybolts is developing commendable interest in the boiler shops. This formerly difficult operation is now performed in very much the same manner as on rivet heads, with great economy of time and effort.

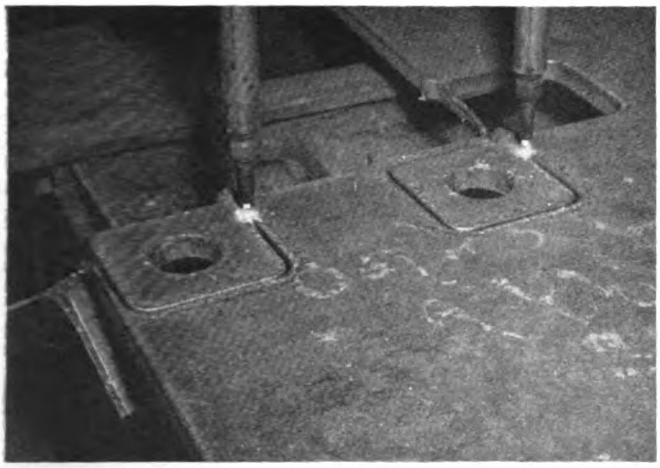
Effect of Flame Cutting on Steel

Reflections are still occasionally heard of the belief that the metal immediately adjacent to the cut edge has been injuriously affected by the localized heating that results from the cutting. Much has been written to prove that for the ordinary low-carbon varieties of steel plate, forgings and castings this effect on grain structure and physical properties is negligible but perhaps further discussion of this interesting subject may be warranted.

It is true that when an oxyacetylene cut is made in a



In making these bottom steam pipe collars ten ¼-in. plates were piled and cut—The 91-in. outside cut was completed in 15½ min., the 33½ in. inside cut in 5½ min.



Injector pipe flanges are formed by the multiple cutting (2 blowpipes) of 1-in. steel plate

steel plate or part, the metal immediately adjacent to the cut is heated considerably above the critical range of the material and immediately thereafter cooled down through this range. The speed of cooling is generally rapid because that heat conductivity of the surrounding metal is high and as the cutting torch or blowpipe is kept constantly in motion, the heating is applied only momentarily at any given point. If the plate or part being cut is not preheated, the cooling is sufficiently rapid actually to cause a chilling or quenching effect on the cut edges, which is particularly noticeable in the case of cutting of heavier plates and forgings.

If any part of a flame-cut edge is carefully polished and etched, microscopical examination thereof will show considerable alteration of the crystalline grain structure of the material immediately adjacent to the cut edge. This change is, however, physical in character and not chemical. The pearlitic structure of the steel will be found to have been transformed into either a sorbitic, troostitic or martensitic form, depending on the carbon content and other elements in the steel. Also, it will be found that there has been an appreciable grain growth at the gas-cut edge. The sorbitic structure that is produced in mild or low-carbon steels is really advantageous as it develops greater strength and toughness and has slightly greater hardness than the original pearlitic structure of the adjacent base metal. Hence, it is universally found that low- and medium-carbon steels are in no way damaged by the flame-cutting operation, but are in effect somewhat improved thereby.

Questions have been raised concerning the effect on welded joints of preparing the welding edges or scarves by flame machining. As a result, there have been several extended investigations to determine whether there is any difference in the physical properties of a welded joint made on scarves so prepared. The net result was evidence that with the reducing atmospheres commonly developed in fusion welds applied with the modern improved processes, the flame-cut edges tend to give a somewhat improved condition in the deposited metal as far as porosity and slag inclusions are concerned. As a result of the published reports on these investigations, various code-making bodies have removed all restrictions pertaining to welding on edges of surfaces that have been prepared by flame cutting, provided the carbon content of the steel does not exceed .35 per cent. In general, machine flame cutting is considered beneficial as compared with other methods of preparing plate edges for welding.

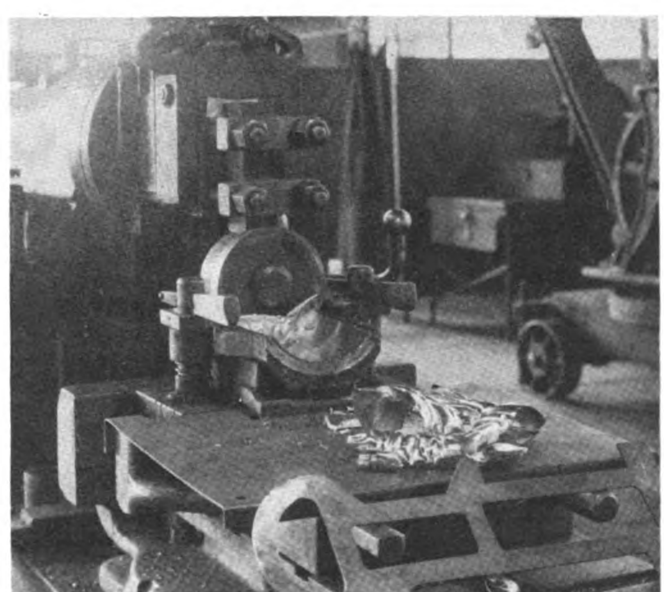
Recently, considerable attention has been devoted to the problem of the effect of flame cutting on the higher-carbon steels and the alloy steels. It is found that the higher-carbon steels can be successfully cut if preheated or subjected to a suitable post-heating treatment. Such treatment may be confined to the affected zone of local torch treatment. The same applies to the various high alloys but little concern is given to the so-called low-alloy steels as most of them perform very much like the low-carbon steels when subjected to flame cutting.

Extensive investigations have been made of the effect of flame cutting on nickel-alloy steel of the customary two per cent nickel variety that have been so extensively used in locomotive boiler construction. With this material the changes caused by the heat of cutting are very similar to those resulting from the flame cutting or ordinary low-carbon boiler plate. The total depth to which the structure is usually altered is .05 in. The grain structure in the nickel steel is much finer adjacent to the cut edge than that resulting in plain carbon steel. There is a band of slightly hardened surface immediately adjacent to the cut edge but this hardness is accompanied by toughness very much the same as the sorbitic structure that occurs in a cut edge in ordinary low-carbon steel. The hardness readings on the cut surface are only a very few points higher in the case of nickel-alloy steel and there was consequently no reason to believe that any different precautions need be taken with this material than with the ordinary low-carbon steels.

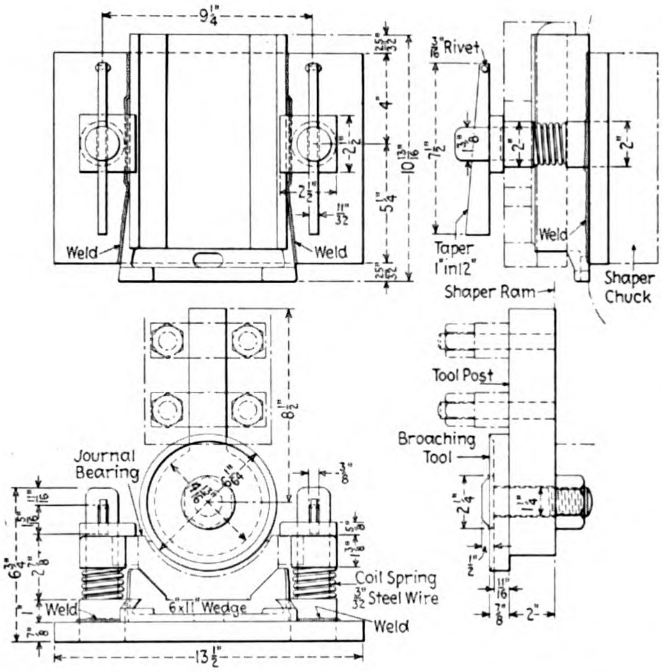
Journal Brass Broaching Jig

The illustration shows a car-journal broaching jig which is now being used with good results on the Chicago & Illinois Midland. The particular jig shown is for 6-in. by 11-in. bearings, but similar jigs have been constructed for all standard size journal brasses.

The base of the device is a journal box wedge electrically welded to a heavy steel plate which is machined with lugs to fit on the ways of a shaper or planer bed as well as being machined to fit the jaws of the shaper chuck. The jig and shaper chuck is used only when a few



Broaching jig in use on an American 32-in. crank shaper



Jig used on the C. & I. M. for broaching 6-in. by 11-in. car journal bearings

brasses of each size are to be broached. When this operation is required on any considerable number of brasses, the jig is clamped directly to the shaper table which gives a more rigid base to work from and permits speeding up the operation.

Referring to the drawing, the general construction of this car brass broaching jig will be apparent. The brass, of course, rests on the wedge and is held down by a quick clamping arrangement which consists of two 1⅜-in. round vertical steel posts equipped with square holding washers which have a bearing on each side of the brass and are held down by a taper key and slot in the upper end of each post. As originally constructed, these posts were threaded and equipped with nuts, but, even when free running, this construction was found to slow up the operation and be less satisfactory than the taper key and slot arrangement illustrated.

The broaching tool itself consists of a heat-treated circular steel plate, in this instance $6\frac{1}{64}$ in. in outside diameter, suitably relieved to give a good cutting edge around the entire circumference and mounted on a 1¼-in. machine bolt which is an accurate fit in the tool holder carried by the shaper ram, the shaper used in this instance being an American 32-in. crank shaper. Being circular in shape, the broaching tool may be rotated as soon as one side becomes slightly dull or chipped, and a new cutting surface brought to bear. As many as 800 brasses have been broached without having to resharpen the tool. For quantity production with one size of journal brass the average time required is two minutes per brass.

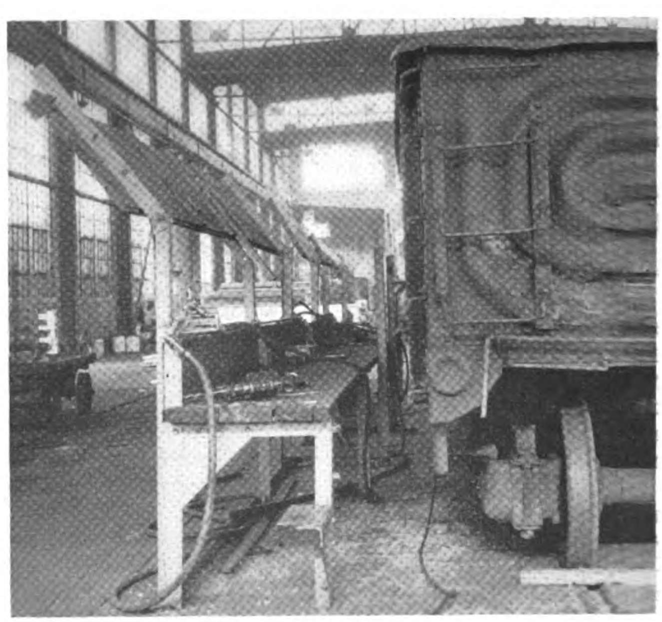
The C. & I. M. has been using this broaching device for more than a year and a careful check of rebroached brasses which are applied only to company-owned equipment shows good mileage and trouble-free service. One important consideration is care in the selection of brasses to be broached. Gages, made in accordance with the A. A. R. Manual of Standard Practices, are used to check all brasses before being broached to make sure that they comply with the A. A. R. requirements. One of these gages is shown lying on the shaper table in the foreground of the photograph. In this view the broaching tool has completed about one-half of its work stroke.

Efficient Scaffolding Used At Monon Car Shops

The illustrations show several different types of scaffolds which serve effectively to expedite car maintenance and rebuilding operations at the Lafayette, Ind., freight car shop of the Chicago, Indianapolis & Louisville, or Monon Railway as this road is more familiarly called. The shop itself is a modern steel structure with a large proportion of the wall area devoted to window space which makes for exceptionally good lighting conditions. A 20-ton traveling crane with an auxiliary is available for lifting operations and greatly increases the productive capacity of this shop in which cars are repaired by the progressive system, being moved from one position to another along each shop track, with material, tools and men available at each position to perform the specialized operation assigned to that point. The shop is notable for its cleanliness, good order and the provision of numerous labor-saving devices.

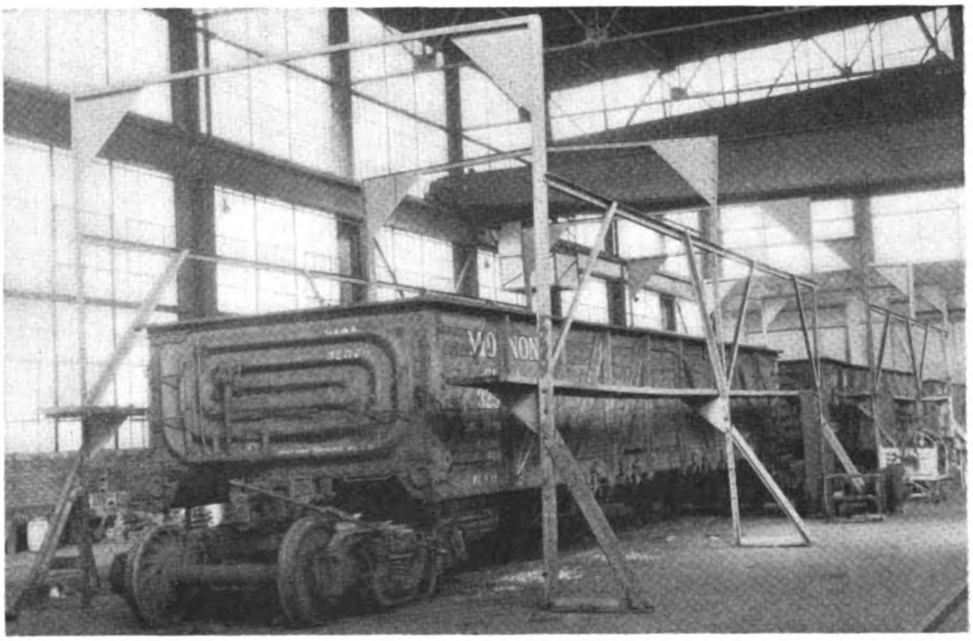
Particular emphasis is placed on the provision of facilities enabling the men to work to the best advantage. The portable adjustable scaffold, shown in one of the illustrations, for example, provides a safe footing at any level desired along the side of any car, regardless of type, whether it is a box car, high-side gondola, or a lower car. The scaffold frame is made of 3-in. Z-bars, the vertical posts on either side of the car having a substantial footing on the shop floor and being tied together with a horizontal bar at the top. The scaffold framework is stiffened with web plates at the upper corners and angular Z-bars elsewhere so as to form a light but rigid flange support for the vertically adjustable brackets and wood platforms. This platform scaffold occupies little floor space and interferes in no way with the excellent lighting conditions throughout the shop. The scaffold may be readily moved by use of the shop crane either from one track to another in the shop or longitudinally on the track as required for the most efficient handling of program repair work.

A two-level scaffold, shown in another of the illustrations, also is portable although not ordinarily moved very often. This scaffold consists of a steel framework supporting a double platform 28 in. wide extending the



Double-deck scaffold with upper deck tipped back so the lower deck may be used

Portable adjustable scaffold used at the Lafayette, Ind., freight-car shop of the Chicago, Indianapolis & Louisville



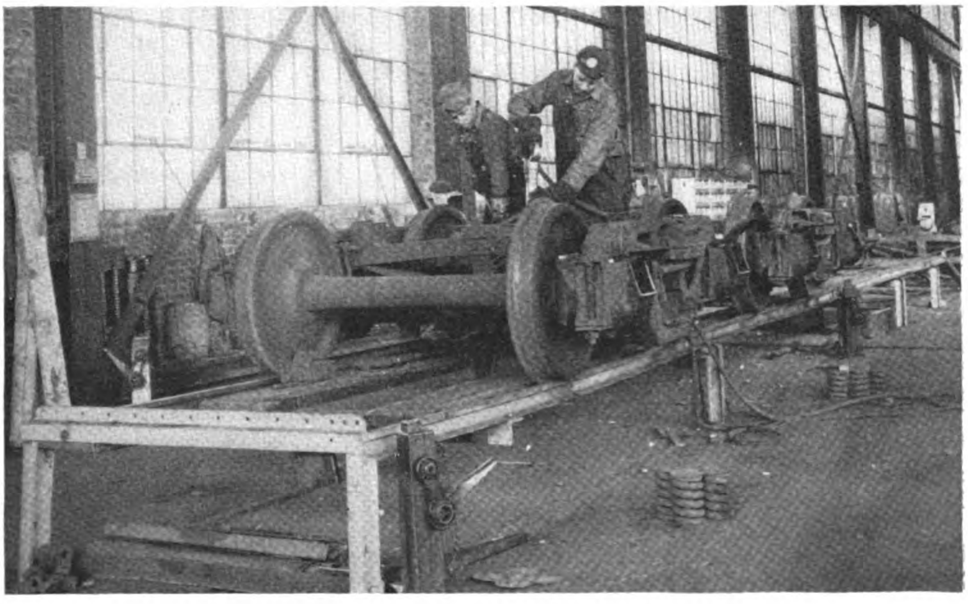
full length of one car, one platform being 35 in. high and the other 70 in. above the shop floor. The upper wooden platform is bolted to five angle cross bars which are pivoted in vertical extensions of the outer steel frame and may be tipped back out of the way to an angle of about 40 deg. when car men are working on the lower level. When the height of the car side or other condition makes it desirable for carmen to work at the upper level, two men can readily swing the upper platform back to a horizontal position where it is held by extra swing legs and gives a firm footing for work at the higher elevation.

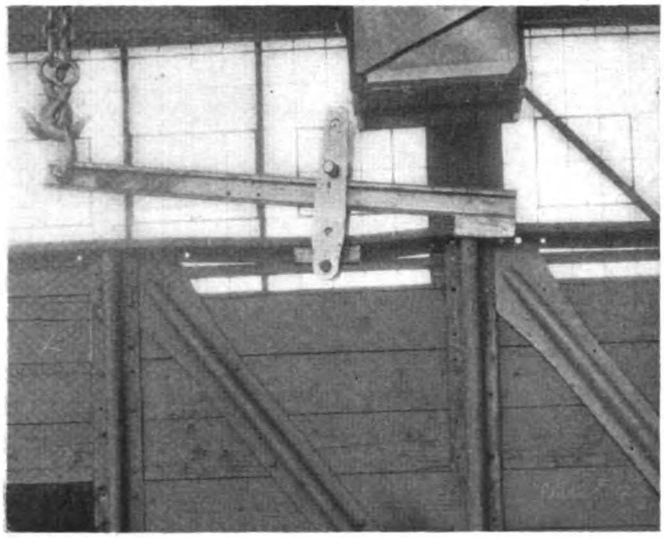
The two-level scaffold is equipped with air connections for the operation of pneumatic tools, as shown in the illustration. A sheet-metal foot plate riveted to one leg of the scaffold gives easy access to the working platform.

The top bulb-angle straightener, shown on the next page, is a simple but effective means of using power supplied by the shop crane to straighten parts such as the top bulb angles of gondola cars, these angles having been bent through the more or less careless use of unloading buckets. The straightener consists of a short section of 75-lb. rail, which bears at one end on the top bulb angle over a side post, has a bolted clevis extending under the bulb angle at the point of maximum deflection and a U-bolt at the other end for attachment to the crane hook. Raising of the crane hook obviously straightens the bend in the bulb angle and the hook is raised until there is a slight upward bend in the bulb angle so that, on the release of pressure, the bulb angle will spring back just enough to bring it straight. Two small steel plates welded to the rail base serve as retainers to keep the end of the rail from slipping off the bulb angle during the straightening operation.

The illustration below shows two 60-lb. rails about 33 ft. long, elevated 26 in. above the shop floor and spaced so as to support freight car trucks which are passing through the shops for repairs or rebuilding. The use of these elevated rails brings the trucks to a height where they can be worked on conveniently by men standing on the floor and performing such operations as applying the side frames and associated parts. Between the tracks, a plank is placed adjacent to each rail to

Raised track which facilitates work at the truck repair position





Device used in straightening the top bulb angle of a gondola car

serve as a footing for operations which must be performed with men standing at that level.

The supports for this truck repair track consist of five welded rail sections as shown in the illustration. The 33-ft. rails are parallel with the shop floor except for 8 ft. at the further end where they are bent down and serve as a runway to permit rolling the trucks to the shop floor by gravity should the shop crane not be available.

Air Brake Questions and Answers

D-22-A Passenger Control Valve (Continued)

625—*Q.—How can the brake rigging be checked for failure to release?* A.—Close the brake-cylinder cut-out cocks and vent the brake-cylinder air to the atmosphere. If the brake-cylinder pistons return to release position, the brake rigging is not at fault. Open the brake cylinder cut-out cocks.

626—*Q.—How would you check for trouble in the relay valve?* A.—If the trouble has not been located in the control valve or brake rigging, it indicates that the difficulty is with the relay valve. A plugged atmospheric vent port leading to the outer face of the inshot diaphragm, or leading to the spaces between the differential diaphragms, may be the cause of failure of the brakes to release. If the vent ports are open, the portion should be removed for further investigation on the standard test rack.

627—*Q.—What is the next test in order?* A.—The service stability test.

628—*Q.—How is this test conducted?* A.—Move the device handle to position No. 1 to recharge the brake pipe and reservoirs to 70 lb. Move the device handle to position No. 5, reducing the brake-pipe pressure 20 lb., then slowly return the handle to position No. 3 (lap). This test must not produce emergency.

629—*Q.—If graduated release is used, what test should be made at this time?* A.—The graduated-release test.

630—*Q.—How is this test made?* A.—Move the device handle to position No. 1 until the brake-pipe pressure has increased 5 to 6 lb., then return the handle to position No. 3 (lap). Repeat the operation several times. At least two graduations should be obtained in this test.

631—*Q.—What is the next test in order?* A.—The emergency test.

632—*Q.—How is this test made?* A.—Move the test-device handle to position No. 1 to recharge the brake pipe and equipment to 70 lb. Move the device handle to lap position for five seconds to determine if the equipment is completely charged. If the brake pipe drops, the reservoirs are not charged to brake-pipe pressure. With the equipment charged to 70 lb., move the device handle to lap position, then open the test-device cock 3/8 in. This test must produce quick action, as indicated by the opening of the vent valve by the time the brake-pipe pressure drops 10 lb.

633—*Q.—In rare instances, what may cause failure to produce quick action?* A.—It may be caused by a decrease in the quick-action chamber volume in the pipe bracket, due to the accumulation of excessive moisture, or it may be due to a restricted quick-action chamber charging choke.

634—*Q.—What test should follow the emergency test?* A.—The release test after the emergency.

635—*Q.—How is this test made?* A.—At the completion of the emergency test, wait approximately one minute before attempting to release in order to permit the vent valve to close. Move the device handle to position No. 1, charging the brake pipe to 15 lb., then move the handle to lap position. Note that the brake-pipe pressure continues to rise, indicating that the emergency piston has moved to accelerated release position. Then move the device handle to position No. 1 until the brake-cylinder pistons move to release position.

636—*Q.—What pressure is developed in the displacement reservoir from a 20-lb. service-rate reduction of brake-pipe pressure from 70 lb.?* A.—50 lb.

637—*Q.—With 50 lb. pressure in the displacement reservoir, what will be the brake-cylinder pressure when the Type B relay valve is installed on a car having the D-22-A control valve?* A.—Approximately 50 lb.

638—*Q.—What will be the brake-cylinder pressure when the A-4-A relay is used?* A.—With the brake rigging designed to produce 25 per cent maximum braking ratio, the brake-cylinder pressure developed from a 20-lb. service-rate brake-pipe reduction will be approximately 30 lb.

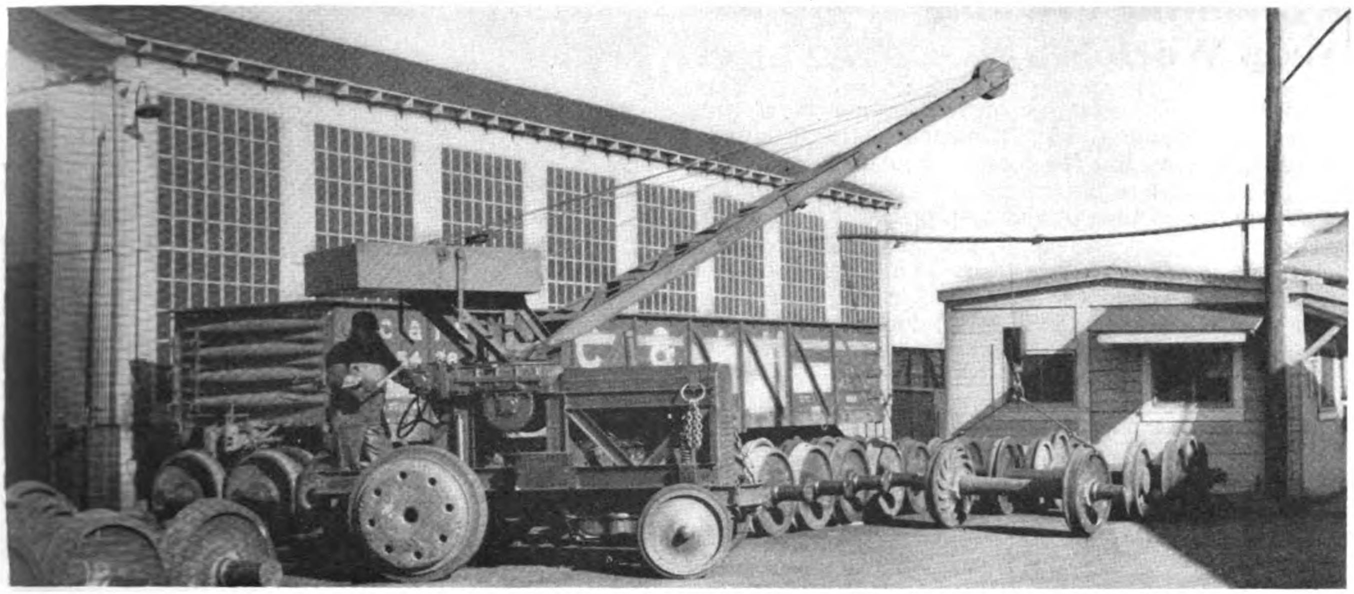
639—*Q.—What brake-cylinder pressure is obtained from an emergency brake application from 110 lb. brake-pipe pressure with the Type B relay valve?* A.—Approximately 95 lb.

640—*Q.—What braking ratio will this brake-cylinder pressure develop?* A.—150 per cent.

641—*Q.—How does this compare with the emergency braking ratio on cars having universal valve equipment?* A.—The maximum braking ratio is the same with both the control valve and the universal valve equipment.

Portable Roustabout Crane

The roustabout crane, manufactured by Hughes-Keenan Co., Mansfield, Ohio, is mounted on a J. I. Case tractor and is now being used effectively in the car department, as well as the locomotive and stores department of the Chicago & Illinois Midland at Taylorville, Ill. Cranes of this type are used for handling car wheels, axles, truck



Hughes-Keenan Roustabout crane in service on the Chicago & Illinois Midland at Taylorville, Ill.

sides and all heavy material on the rip tracks. One of the big advantages is the 18 ft. boom with a 6 ft. extension which is carried on a roller bearing turntable to give greater flexibility and permit transferring material from one position to another without moving the crane at every lift. The weight of the boom is counter-balanced, as shown in the illustration, and the boom may be operated through a complete radius.

The controls of both the speed and lifting of this crane are such that the load or the crane may be operated individually and at either a slow or rapid rate. The crane design permits handling freight-car wheels, for example, through the car yards safely at a speed of 15 m.p.h.

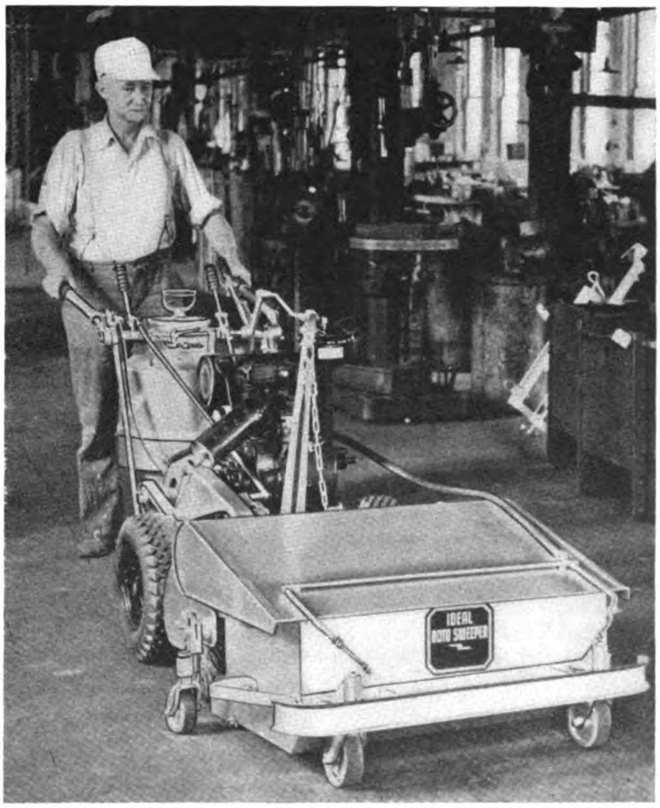
Cranes of this type are available in three sizes, having maximum recommended lifting capacities of 5,000 lb., 8,000 lb. and 10,000 lb. respectively. The larger size machine can lift about one ton at 20 ft. from the center of the turntable.

Power Sweeper for Cleaning Large Floor Areas

The Ideal Roto Sweeper, manufactured by the Ideal Power Lawn Mower Company, Lansing, Mich., will sweep an average of 36,000 sq. ft. of floor surface an hour. It is designed for the inside sweeping of large floor areas in shops and industrial plants, the outside sweeping of docks, platforms and pavements, and for sidewalk snow removal.

This sweeper works equally well on concrete, wood, tile, brick or asphalt. It will pick up both light and heavy sweepings of dirt, dust, sand, gravel, iron filings, borings, cinders, paper and commercial sweeping compound. A sprinkler, regulated to keep the fiber bristles of the brush moist, prevents the raising of any objectionable amount of dust. Where the cleaning problem includes the removal of hard grease, the sweeper can be equipped with a steel wire brush which cuts the grease and deposits it in the dirt box.

The sweeper is equipped with a power-driven brush, 14 in. in diameter, having special fiber bristles. The brush turns at the proper speed in a counterclockwise direction to pick up the sweepings and carry them over a rubber deflector into the dirt box. The machine may be furnished with either the straight or angle type brushes which are interchangeable and can be used on the same unit as desired. Where there are long stretches of straight sweeping, a riding trailer for the operator adds materially to the usefulness of the equipment.



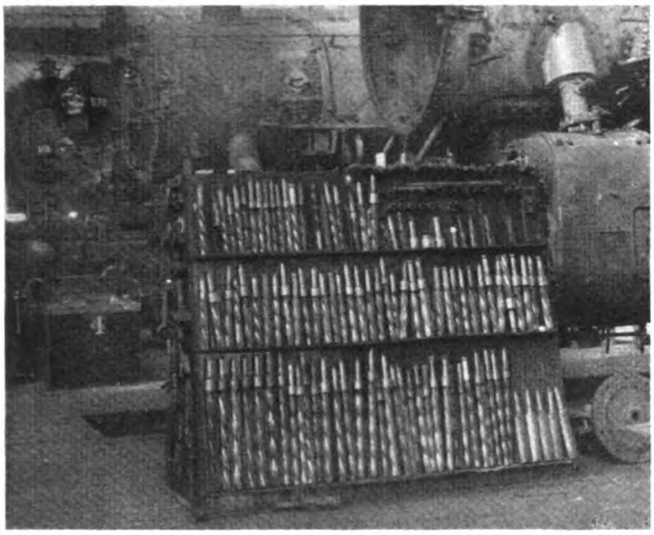
The Ideal Roto Sweeper picks up both light and heavy sweepings —It can be equipped with a steel wire brush for removing hard grease

Expediting Erecting Shop Work

Every effort is made to expedite locomotive erecting shop work at the Chicago, Indianapolis & Louisville shops, Lafayette, Ind., by locating both tools and materials, whenever possible, where they can be secured with minimum loss of time by the shop men who need to use them. Take, for example, locomotive frame reamers, which are usually kept in a toolroom and issued only on check. These reamers are kept out in the open at the Lafayette locomotive shop in a rack located in the erecting shop immediately adjacent to the pits where locomotive frame bolts are fitted. The other side of this rack, shown in one of the illustrations, is used for drills, and various other tools necessary in erecting shop work are suspended from hooks or pins in the ends of the rack.

Whenever a machinist and his helper, therefore, needs to ream a frame-bolt hole, it requires only a few steps to secure the necessary reamer, perform the operation and return the reamer to the rack without the necessity of going all the way to the tool room, possibly waiting in line for issuance of the reamer and subsequently returning it in order to get the brass check which has been left at the tool room and covers the issuance of this tool.

Shop foremen are responsible for seeing that all tools are returned to the racks at the end of each day's work and a glance at the rack indicates whether or not this has been done. A little extra attention is required when first inaugurating this method of dispensing small tools, but, in a shop the size of the one at Lafayette, experience seems to show that the formality of supplying small tools from a central tool room may be dispensed with at least for tools such as frame drills, special wrenches, and reamers without losing the tools and with general benefit to the shop production.



Small tool rack conveniently located in the erecting shop where the tools are used

A compact and substantial work bench, equipped with vices, is also located near the end of each pit, with the same object of saving the time of erecting shop men in the performance of various detailed operations which require the firm support and holding of various locomotive parts while being filed or fitted. One of these work benches, designated by the figure 4, is shown at the left in the illustration. A feature of this bench is that the underneath part is closed and cannot be used for the storage of either tools or materials which must therefore be kept in the open where they can be readily seen and hence available for use when needed. One floating or portable bench is also available and is moved by the crane to any location when needed, and after use is removed to clear the floor.

Cotters are also conveniently available in partitioned shelves in a building column at the wheeling pit

As in the case of small tools, certain materials and supplies, generally required for the repair of all locomotives, are kept in the erecting shop immediately adjacent to the pits where they will be used, to save time formerly required in locating the shop foreman, getting an order, and going to the storeroom for the material. For example, all sizes of cotters used at the wheeling pit are kept on partitioned shelves made of light-gage sheet metal and welded in between the web and flanges of the steel building column immediately ahead of the wheeling pit.

This is a neat arrangement which takes advantage of hitherto unused space and not only saves the time of men working at this pit but actually saves material as well, since, with all the cotters they need immediately available, the men are not tempted to order more than will be required from the storeroom and hence possibly waste some of them. The sign at the top of this column "Help to Keep Your Shop Clean and Safe" is significant of the general conditions maintained at the Lafayette shop, which is notably clean and well picked up.

Cans are provided for waste materials of all kinds, as shown at the right of the column, and the provision of a generally clean shop assures both safety and increased production over what would otherwise be obtainable.

Gage for Checking Wheel Quartering

This shop-built gage takes all the guess work out of mounting wheels on the true quarter and provides an accurate check when wheels are suspected of being out of quarter.

The blade of this tool is a 24-in. heavy-duty Brown and Sharpe steel scale. The measuring device is part of a bevel protractor. This is fastened to the blade with two small thumb nuts on the back of the gage using copper washers between the nut and the scale to prevent marring the scale and is readily adjustable.

When using this tool to line up new or rebored wheels a sliding point on each side of the protractor is used. The protractor is set at 45 deg. and a temporary center is located in both the axle fit and the crank pin fit. The centers of the gage are then set to this distance. The wheel center is placed on the end of the axle in approximate position and the gage held in the centers. The wheel center is moved one way or the other until the bubble of the level attached to the protractor is centered. The wheel center is now in its proper position and it is blocked there. The same procedure is carried out on the other wheel and the keyways are scribed ready for machining. Obviously the pins must be 90 deg. apart.

When checking mounted wheels with the crank pins already in place, a centering head is put on the scale in place of one of the center points and over the other point is slipped a ball of sufficient diameter to fit in the axle center. The gage is held in position as shown and the level moved until the bubble centers. A reading of the protractor is then taken and the same method followed on the opposite driving wheel. If the wheels are properly quartered, the combined protractor readings will be exactly 90 deg. If it is not exactly 90 deg., it shows that the wheels are out of quarter and how much.

Method of using wheel quartering gage to check mounted wheels

Milwaukee Locomotive Shop Methods and Devices

At the Milwaukee, Wis., locomotive shops of the Chicago, Milwaukee, St. Paul & Pacific, a number of methods, devices and new shop tools have been developed or installed to expedite locomotive repair work and reduce the important items of maintenance cost and out-of-service time. The total investment involved in these labor-saving devices and new shop tools is small as compared with the economies effected.

Typical of the shop practices which reduce locomotive maintenance cost and out-of-service time is the welding of back cylinder heads to cylinders, using the method shown in Fig. 1. A leaky back cylinder head is "bad news" at any enginehouse, for it means pulling a piston, removing the main rod, crosshead, guides and cylinder head, providing a new cylinder head bearing surface (probably ground in by hand or by machine to make a steam-tight joint on the cylinder), and all parts then being re-assembled in the machine. Quite a number of man-hours of labor are involved in all of these various operations, during which the locomotive must be held out of service and there is always a possibility that the leak may develop again at some future date.

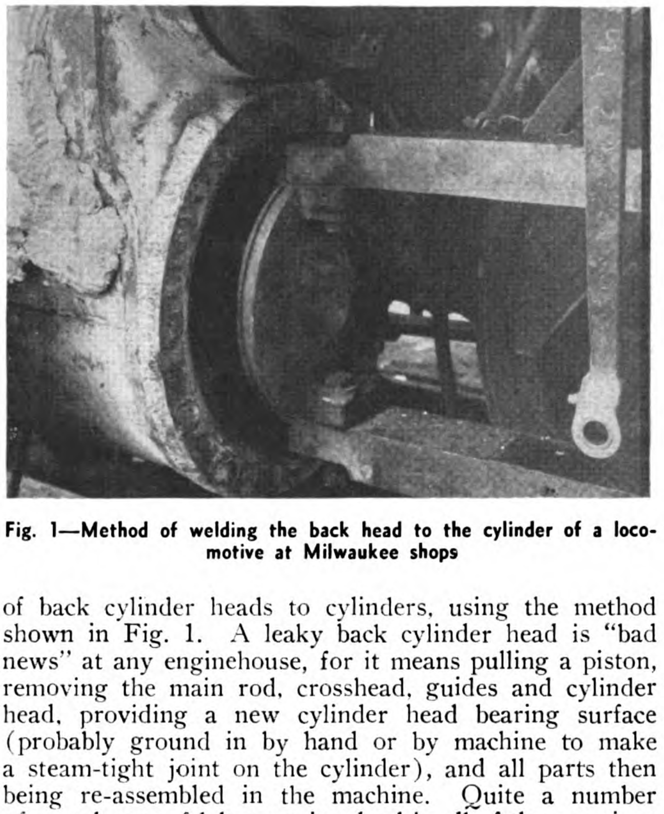


Fig. 1—Method of welding the back head to the cylinder of a locomotive at Milwaukee shops

In order to make a permanent repair job with every assurance of preventing steam leaks at this point throughout the life of the locomotive, the Milwaukee is now following, as more or less standard practice, the welding of back cylinder heads to locomotive steam cylinders. When a locomotive comes to the shop for heavy repairs, the motion work, the guides and back-cylinder-head nuts are removed. The old studs are then cut off flush with the cylinder head, usually with an

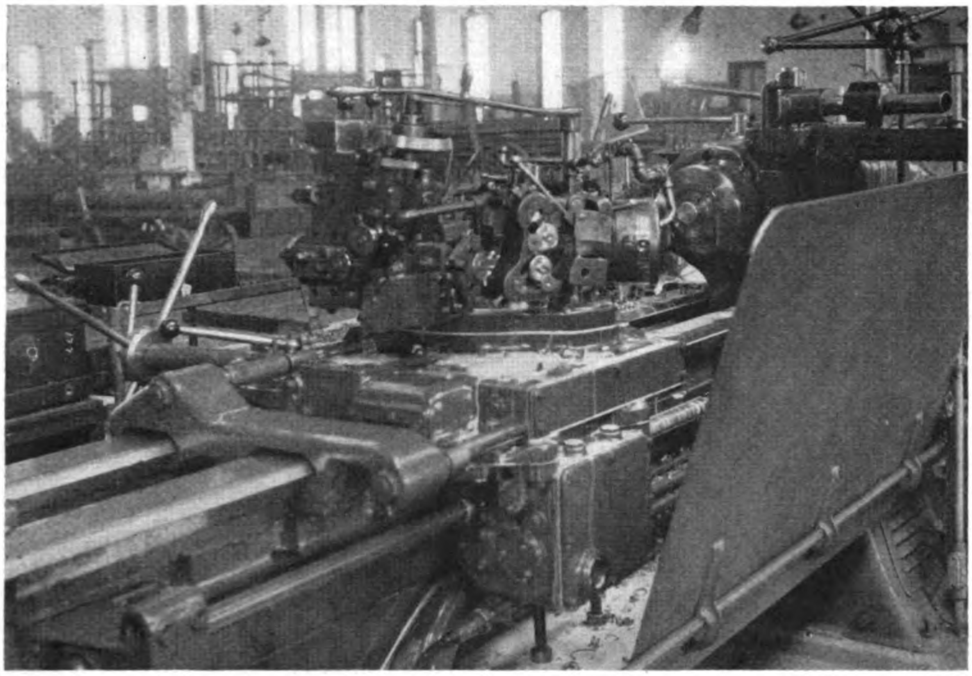


Fig. 2—One of the new J. & L. 2½-in. turret lathes used in machining engine bolts from bar stock

oxy-acetylene cutting torch. Each cylinder (working separately on one side of the locomotive at a time), is pre-heated with a charcoal or briquet fire. The studs are then welded to the cast-steel cylinder head by the electric-arc method, enough metal being deposited on the head of each stud to develop the full holding power of the stud. Bronze welding is used to fill in the space between the cylinder and the cast-steel cylinder head and make a positively steam-tight joint, the electric welded studs simply giving ample reserve of holding power to keep the cylinder head rigidly in place. On completion of the welding operation, the cylinder is kept covered and the fire permitted to go out, the cylinder cooling off in a period of 8 to 10 hr. The direct labor for this welding job is supplied by two welders, who spell each other over an 8-hr. period. About 30 to 40 lb. of bronze are required for the welding on each cylinder head.

In Fig. 2 is shown one of two 2½-in. J. & L. turret lathes recently installed at Milwaukee shops, which are giving good results with Vascoloy cutting tools in machining all kinds of engine bolts, both straight and taper, direct from bar stock for system shop and enginehouse work. The 18-in. taper attachment used on this high-production machine is very convenient and enables adjustments to be made quickly. A third 3-in. J. & L. machine is used on brass bushings and motion-work pins, taking the place of two engine lathes. For this work, a surface speed of 500 ft. per min. or better is practicable when sintered carbide cutting tools are used.

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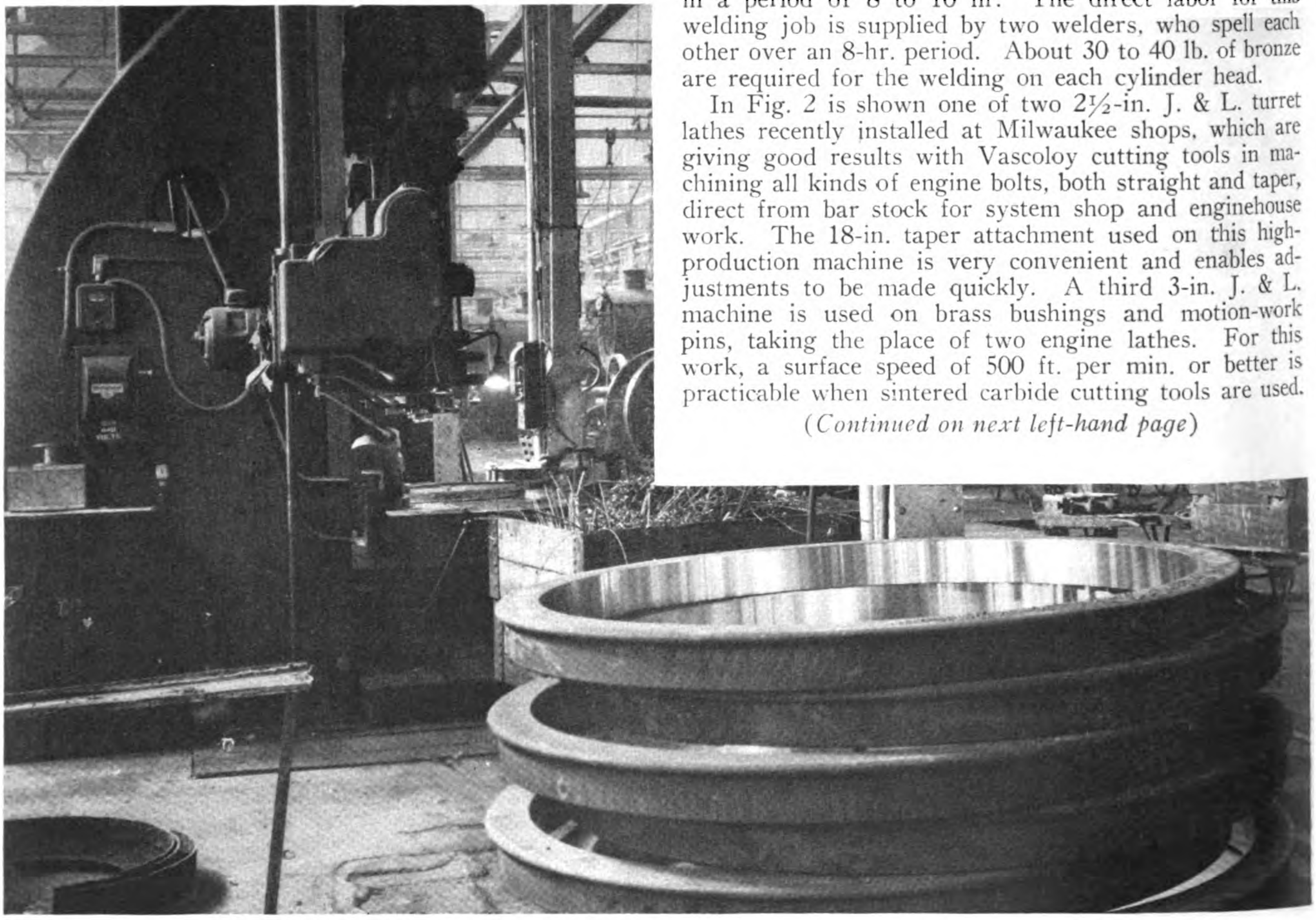


Fig. 3—Betts 100-in. heavy-duty boring mill—The set of tires in the foreground was bored with sintered-carbide cutting tools

The Betts 100-in. vertical boring mill, illustrated in Fig. 3, is a comparatively new machine tool installed at the Milwaukee shops, which has given a good account of itself for all heavy-duty boring operations. On account of the rigidity of the machine and its design for the use of high cutting speeds when necessary, the machine has proved its value for boring locomotive driving-wheel tires in what has come to be the accepted modern practice, namely, by the use of cutting tools of the cintered carbide type with high surface speeds. In this instance, two Vascoloy-Ramet cintered-carbide tools, one for roughing and one finishing, are used simultaneously, one in each head of the boring mill to finish the bore of the tire at one operation. While higher speeds are sometimes used, experience at this shop indicates that a surface speed of about 180 ft. per min. gives the best results over a period of time, the depth of cut varying from .125 to .250 in., and the feed from .025 in. to .032 in. At higher speeds the cutting tools will not hold up. The boring time complete is 22 min. per tire and the setup time 5 min. The highly polished surface on the set of finished tires, shown in the foreground of the illustration, indicates the exceptionally smooth job done in this boring operation.

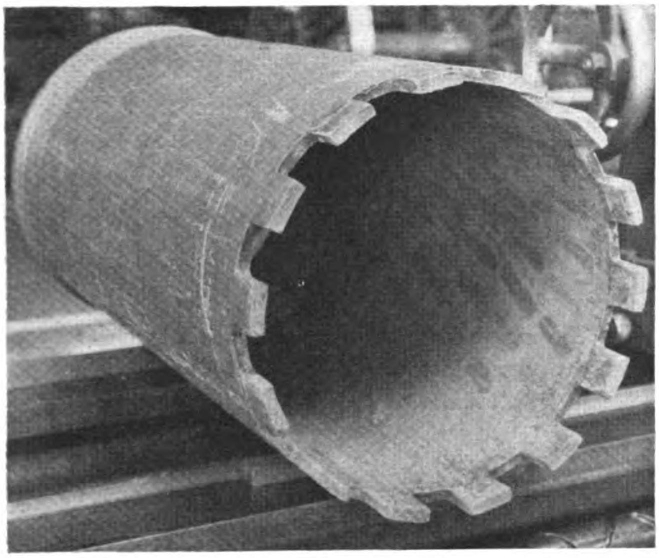


Fig. 4—Chilled spots are cast on the inner surface of an inside smoke-stack extension to prevent cinder cutting

Another interesting method of securing increased service life for a locomotive part subject to rapid wear by the action of exhaust steam and cinder abrasion, is shown in Fig. 4. The inside smoke stack extension, illustrated, is a type used with the Anderson front end, which has no netting but depends upon setting up a swirling action of the exhaust gases to break up the cinders against suitable vanes, and thus prevent any sparks leaving the stack. The downward-projecting smoke stack extension in the front end is subject to quite severe erosive action and, to secure greater life for this inside stack, which is made of cast iron, 1-in. by 4-in. chillers are set equally spaced and at a slight angle to the axis on the inner surface, which therefore has 1-in. by 4-in. chilled spots all around the interior of the casting and hence retards the wear due to cinder cutting. The chillers are omitted from a band at the top of the stack which must be machined to fit the smoke stack base and have a lip, as shown in the illustration, which permits the casting to be supported from the stack base.

Locomotive Boiler Questions and Answers

By George M. Davies

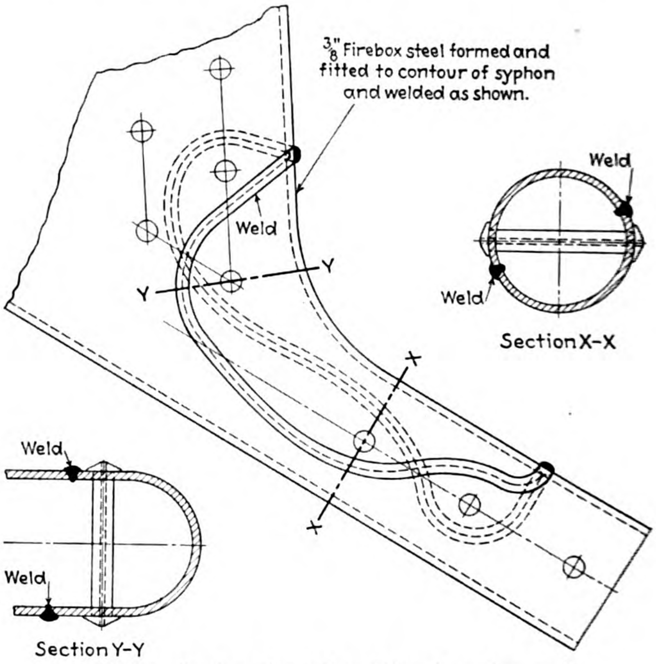
(This department is for the help of those who desire assistance on locomotive boiler problems. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless special permission is given to do so. Our readers in the boiler shop are invited to submit their problems for solution.)

Design and Application of Thermic Syphon Patches

Q.—We have had several of our thermic syphons crack in the top of the syphon neck. Is it satisfactory to weld these cracks or should they be patched? What type of patch should be used?—M. I. T.

A.—Circumferential cracks in the top of the neck of a syphon should not be welded but should be patched. The diagram illustrates a typical patch for the neck of a syphon.

The cracked section of the syphon neck is removed by use of an acetylene torch. The cut should be made so that in welding the patch to the old section, the welds are not opposite each other. The patch should, where possible, be made in a saw-tooth manner, alternating the so-called teeth in order that the staybolts will be in a section of the patch on one side and in an old section of the syphon on the opposite side, as shown in the illustration. The patch should be formed to the contour of the section removed and butt welded in place. Lap welds should not be used to avoid fire cracks due to double thickness of metal.



Typical application of patch to Thermic syphon neck

Repairing Cracks in Firebox Side Sheets

Q.—Several cracks have developed in the firebox side sheets of our Mikado type locomotives. These cracks extend from

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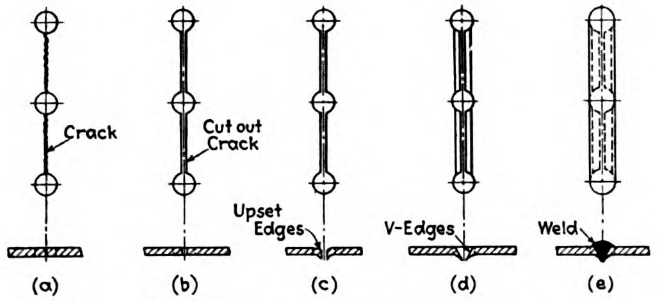


Welding cracks in firebox side sheets

staybolt hole to staybolt hole. Is it unsatisfactory to vee out and weld the cracks or should the area around the cracks be removed and a patch applied?—M. K. O.

A.—When a crack in the firebox side sheets extends from staybolt hole to staybolt hole, it is satisfactory to weld it provided the crack is in a straight line and in no case shall any crack so welded extend more than two staybolt holes as illustrated in Fig. 1 (a). If the crack extends more than two holes or if there are other cracks adjacent to it a patch should be used.

The general practice for repairing a crack in the firebox sheets is as follows: Cut out the crack with an acetylene torch as illustrated in (b), making the smallest cut possible. Then upset edges of plate (c), driving the plates in from the fire side of the sheets, forming a V-shaped opening as shown in (d). Weld the entire opening including the staybolt holes as in (d) and redrill and tap for the staybolts.

Effect of Boiler Pressure On Leaking Staybolts

Q.—What causes fireboxes that are tight in service to show leaks around staybolt heads when cooled down below working pressure?—P. A. T.

A.—Leaks around staybolt heads when cooled down below working pressure are primarily due to the expansion and contraction of the boiler. Other factors are scale resulting from the use of impure water, improper firing, and improperly fitted staybolts.

The staybolts work in the sheets because the expansion of the firebox sheet is greater than that of the wrapper sheet, causing a greater movement of the firebox sheet as compared to the wrapper sheet. A staybolt may be tight before the boiler is heated and show no signs of leaking while the boiler is fired up and under pressure although the staybolt fit in the sheet has been broken due to the sheets working. The action of the sheets due to expansion keeps the staybolts tight. However, when the boiler is cooled down an opposite action takes place. The sheets contract which relieves the pressure on the staybolt fit in the sheet, allowing the bolt to leak.

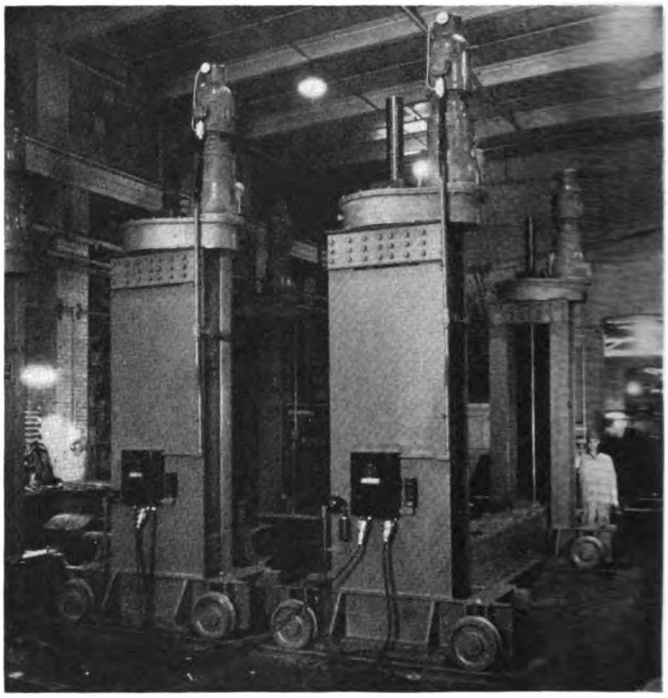
Whiting Pitless Locomotive Hoist

A pitless locomotive hoist which can be supplied with either four or six jacks, each of which can be separately racked on a narrow-gage track at ground level, has been developed by the Whiting Corporation, Harvey, Ill. The hoists range in capacity from 200 to 250 tons with four jacks and from 300 to 400 tons where six jacks are used. The jacks run on narrow-gage tracks at ground level—a track for each side of the locomotive. Since all of the jacks are movable, close spotting of the locomotive is not required.

Another novel feature is the vertically placed geared-head motor located at the top of each jack, thus providing an individual drive through a pinion and gear. The revolving hoisting screw attached to the gear raises and lowers the hoisting-screw nut—one for each jack, operating in pairs. A pair of these nuts support a lifting beam which, when lowered, passes through a gap in the truck portion of the jack and enters slots in the foundation. In the low position, the beam rests on its foundation with rails on its top side coincide with the locomotive track rails—thus forming a bridge across the slots. As in the past, different slots are used, properly spaced apart for different lengths of locomotives. Slots, not in use, are spanned by removable crossover rails.

With an individual drive as described, there is saved the cost of two jack pits, two shaft pits and a motor pit. All cross and main shafting are eliminated with their numerous bearings and shaft carriages. Because of no pits, no removable pit planks are necessary. With the use of this individual drive, all clutches for the jacks are eliminated, and it is possible to obtain a higher hoisting speed than used in the past.

The control itself is interesting. Each jack has a two-button control—one for "Up" and one for "Down" movements. In addition each jack has a selector switch for making the jack "Operative" or "Inoperative." There is also a pendant detachable master switch that may be plugged in on either side of the hoist. It is thus possible to operate each jack individually, in pairs, or all jacks at one time.


Manufacturer's shop view of two of the three pairs of Whiting jacks which will be installed as a 300-ton pitless locomotive hoist on the Western Maryland at Hagerstown, Md.

The jacks have low and high limit switches. The lifting beam that is the highest during raising movement rings a bell before reaching the extreme high limit. When high limit is reached, hoisting movements cease for all lifting beams. Most of the wiring is located in conduits. Only enough remains outside to make possible

(*Continued on next left-hand page*)

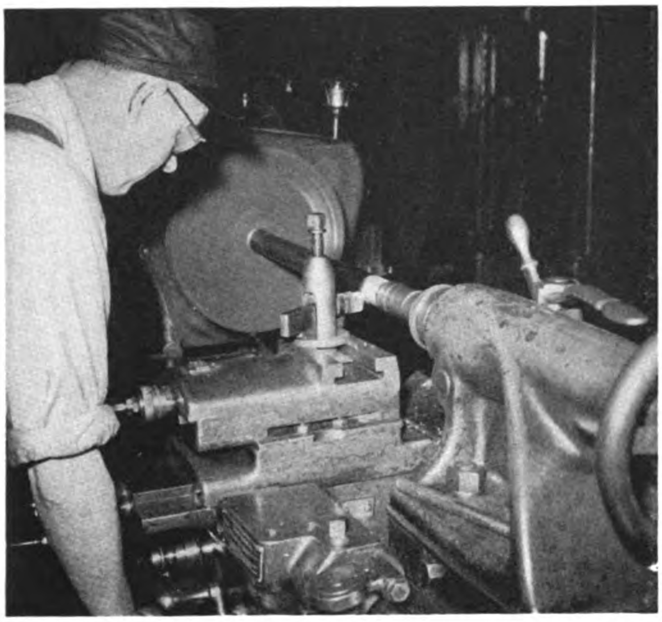
the movement of the jacks from minimum to maximum travels.

The shop view accompanying this article shows two of the three pairs of jacks constructed for a six-jack, 300-ton locomotive hoist, purchased by the Western Maryland for use at Hagerstown, Md. Each jack has a 10-hp. motor, and heavy power will be raised on the hoist for wheeling and unwheeling purposes.

Metal-Sprayed Parts Finished with Carboloy Tools

Many worn locomotive parts that would normally be scrapped are being reclaimed by spraying these parts with stainless steel and re-machining them to size. Other items reconditioned by this process include such parts as shafts, water-pump piston rods and motor armature shafts.

In practice, 18-8 stainless steel in wire form is fed into the back of a gun equipped with an air turbine supplying power to two knurled rolls which force the wire through the gun into the center of a neutral oxy-acetylene flame. By the careful adjustment of the speed of the wire through this flame, a fine atomization and even deposition of the metal on the worn parts is obtained. All surfaces to be sprayed are sand blasted first, using a 30-mesh steel angular grit. This operation not only cleans but also roughens the surface and enables the sprayed metal to adhere to it. The part is sprayed until the size of the part is $\frac{1}{64}$ in. to $\frac{1}{32}$ in. in excess of that to which it is to be machined.



The pump rod after being sprayed with stainless steel is being refinished to size with a Carboloy tool at a cutting speed of 242 ft. per min.

To obtain a fine finish, it was found desirable to turn the sprayed-metal surfaces at high speeds, 200 to 450 ft. per min., using a slow feed and producing fine cuts. For turning operations, Carboloy tools produce good results. On parts that can not be turned, the surfaces are finished by grinding.

The accompanying illustration shows a pump rod being re-machined after having been sprayed with stainless steel. The cutting speed for this job was 242 ft. per min. with a .005-in. feed and a $\frac{1}{64}$-in. depth of cut. The floor-to-floor time for the $1\frac{3}{4}$-in. diameter shaft, two feet long, was 20 minutes, with approximately 12 pieces being machined per grind of the Carboloy tool. These tools are a product of the Carboloy Company, Inc., Detroit, Mich.

Packing of Braided Construction

The introduction of Garlock Lattice-Braid packings brings to industry an entirely new line of braided packing materials and is the result of many years of experimental and developmental work. In this packing, every braiding strand passes diagonally through the body of the packing at an angle of approximately 45 deg. This makes a completely uniform structure. It is braided internally as well as externally. There are no strands in the packing which are not part of and integral with the entire body of the packing. Structurally, every braiding strand contributes to the strength of the entire mass.

In service, all packings are subject to wear on the surface which contacts the moving rod. Eventually, the strands of braided packing on the working surface will wear through. When this occurs ordinary braided packings will go to pieces because the structure of the packing itself is destroyed. With Lattice-Braid packings, this can not occur because when this packing becomes worn it will not disintegrate into a series of loose strands or separate parts.

Large sizes of this packing can be formed into rings around rods of small diameter without distortion to packing due to the fact that every braiding strand passes diagonally through the packing. This packing is made of materials and in sizes to meet the requirements of all types of applications. It is a product of the Garlock Packing Company, Palmyra, N. Y.

Every strand of Garlock Lattice-Braid packing passes diagonally through the body of the packing—It is braided both internally and externally

(*Turn to next left-hand page*)

High Spots in

Railway Affairs . . .

Public Aids To Transportation

The Association of American Railroads has just issued a carefully prepared report of 214 pages, replying to the report on Public Aids to Transportation, which was prepared under the direction of Federal Co-ordinator of Transportation J. B. Eastman, but was not finally issued until 1940—four years after the Co-ordinator's office had been abolished. The preparation of Co-ordinator Eastman's report was expensive, much of the cost being assessed against the railroads. "The railroads," says the A. A. R. report, "have felt impelled in the protection of their interests and to make available an accurate and comprehensive statement, to analyze carefully each volume of these reports." In the conclusion to Part I, entitled, General Comparative Analysis, the A. A. R. report makes this statement: "The apparent conclusion is that if careful appraisal of the economic soundness of projects now in existence or to be brought into existence were made, the uneconomic existing facilities would probably be eliminated by rail, by highway and by water and only useful facilities would be built as new projects. Everyone will probably agree that if sound economic considerations can be made to control additional transportation projects, half the battle will have been won. It has required a most extended discussion to reach such a simple conclusion. Nothing new has been brought forward. Every student of the subject has long known that the primary difficulty is to control additional transportation projects by sound economic considerations, rather than on a political basis. The primary difficulty is that no such economic consideration will be given. This, however, would have been apparent to the writers of this lengthy report if one-half the attention they have devoted to the activities of certain people connected with financing of the railroads more than half a century ago had been given to the pressure groups for new waterways and the nationwide lobby for more extensive highway expenditures and airway expenditures. There is our real difficulty and there our real difficulty remains."

Women Employees On Soviet Railways

According to the Railway Gazette of London, in discussing women on Soviet railways, "thousands of women are working in the railway work shops as mechanics, fitters and turners." While the outside world does not seem to know much about what is going on in the Soviet today, it seems remarkable that women should be used to so great an extent on tasks that are ordinarily considered entirely within the province of men, at least so far as this country is concerned. Another statement that makes one wonder what is going on in the Soviet is that while three years ago there was only one woman engine driver on the Soviet railways, today there are 56 women engine drivers and 2,900 assistant engine drivers. This is in addition to a large number of women employed as motormen of electric trains. In all, it is estimated that more than half a million women are now employed on the railways of the Soviet Union.

"Trust Buster" Arnold After the A.A.R.

The Department of Justice filed a suit against the Association of American Railroads, its members and officers, charging that the railroads had violated the Sherman Act by refusing to enter into through routes and joint rates with motor carriers. It was alleged that this was accomplished by the passage of certain resolutions by the board of directors of the A.A.R. and agreement thereto by the member roads, thus constituting a conspiracy in restraint of trade. The railroads asked for a dismissal of the charge, because of the rescinding of the resolutions in question. Justice Jennings Bailey of the District Court of the United States for the District of Columbia has refused to dismiss the suit and so the railroads are required to answer the original complaint, after which it will go to trial.

What About Rule G And Public Safety?

A Pennsylvania railroad engineer was discharged for violating Rule G. Members of his own crew just prior to starting on their run had reported that he was not in fit condition to operate his train. He was examined by a competent physician, who stated in writing that the engineer was "absolutely unfit to handle an engine, due to the effects of alcohol." According to the railroad, this was not the man's first offense on this and other counts. He had been dismissed in 1935 for being intoxicated, but had been reinstated with the understanding that any further serious infraction of the rules would not be tolerated. He was again dismissed in 1937, but was reinstated on his own promise that any future failure to observe the rules "will be sufficient cause for my being immediately dropped from the service." In spite of this, the First Division of the National Railroad Adjustment Board rendered a decision on November 12, 1940, which restores full seniority rights and back pay to the time that he was dismissed in February, 1939. The board deadlocked on the case and a referee was called in. Apparently the decision was made on a technicality and the man who tried to operate an engine while intoxicated, instead of getting disciplined, got an award. How about the public and its safety? Or the other employees, whose lives are placed in jeopardy by gross infraction of Rule G?

Corn As Railroad Fuel

Argentina has a great surplus of corn. To protect the farmers the government purchased it, paying almost $12 a ton. As there were no markets available for the surplus, it was faced with a serious problem of how to dispose of it; the suggestion was made that the unshelled corn might be used as fuel for the railroads and public utilities. Experiments were made which showed that the unshelled corn, at less than $5 per metric ton, could be used for fuel as cheaply as coal, wood or fuel oil. The Argentine Ministry of Agriculture has therefore authorized the sale of the government-purchased corn for such purposes.

The British Carry On

London may be receiving a terrible "strafing," but it does not seem to interfere to any great extent with our British contemporary, the Railway Gazette of London. Of almost the same size as in normal times and very well printed, its numbers reach this country regularly and with comparatively little delay. The only sign of inconvenience, if it may be called such, is the notation on the masthead directed to "Callers and Telephoners." It states that, "Commencing Monday, November 11, and continuing until further notice, the office hours are Mondays to Fridays—9:30 a. m. to 3:45 p. m. The office will be closed on Saturdays." True, as one leaves over the publication week by week, references are made to the special problems under which the British railways are operating. Such articles, however, are not very numerous and are largely restricted to a section in the news department of the paper, entitled, Transport Services and the War. This section, including the November 15 number, has been running for 64 weeks. On the other hand, "The Scrap Heap," with its odds and ends and humor, still continues to be a feature of the paper. That it can joke, even under war conditions, may be seen from the following quotation, which is an extract from a letter which first appeared in the London Times. "A Swiss friend of ours lately returned to Basle from Hamburg, and had to change trains 52 times owing to the activities of the R. A. F. His only comment was that he wished it had been 70."

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NEWS

A. S. M. E. Honors Superheater Engineer

Carl A. W. Brandt, chief engineer of the Superheater Company, New York, was presented the Melville Medal "for original engineering work" by the American Society of Mechanical Engineers at its annual dinner and honors night on December 4 in New York. Mr. Brandt received the award for his paper entitled "The Locomotive Boiler."

The engineer so honored was born in Stockholm, Sweden, in 1881; studied mechanical engineering there and obtained his early experience with the Swedish Government Railways and the Sweden Atlas Locomotive Works. In 1902 he went with the New York Central and became mechanical engineer and master mechanic of the Big Four in 1910. Mr. Brandt joined the Superheater Company as its chief engineer in 1916. He continues in this position at present in charge of the development and design of locomotive equipment, including superheaters and feedwater heaters, in addition to similar apparatus for stationary power plants.

During the dinner five honorary memberships in the society were awarded. Recipients included James A. Seymour of Auburn, N. Y., inventor and developer of the McIntosh & Seymour engine, as well as numerous other inventions in the application of directly connected high-speed engines to electric generation. Mr. Seymour, in 1886, co-founded McIntosh, Seymour & Co., steam engine manufacturers, which concern later became manufacturers of Diesel engines and is now a subsidiary of the American Locomotive Company. Mr. Seymour retired from active business in 1922.

Equipment Purchasing and Modernization Program

Denver & Rio Grande Western.—The D. & R. G. W. has asked the Interstate Commerce Commission for authority to assume liability for $1,260,000 of serial equipment trust certificates, maturing in 10 equal annual installments of $126,000 on February 1, in each of the years from 1942 to 1951, inclusive. The proceeds of the issue will be used as part payment for equipment costing a total of $1,698,110 and consisting of 500 50-ton, 40½ ft. box cars.

Great Northern.—The Great Northern will soon begin the conversion of 15 steam locomotives at its shops at Superior, Wis., and Hillyard, Wash., at an approximate cost of $1,500,000. Conversion plans provide for almost complete rebuilding of the power units. When work is completed the locomotives will be assigned to freight service on the Kalispell division in the mountainous section of Montana.

Louisville & Nashville—The L. & N. has asked the Interstate Commerce Commission for authority to assume liability for $6,770,000 of equipment trust certificates, maturing in equal annual installments of $677,000 on December 15 of each of the years from 1941 to 1950, inclusive. The proceeds will constitute part of the purchase price of the freight-car equipment, costing a total of $7,527,271, shown in the table of orders which begins on this page.

Union Pacific.—The U. P. is contemplating construction in company shops of 100, 200 or 300 50-ft. lightweight automobile cars of 50 tons' capacity.

The "John Bull" Lives Off the Country-Side

Employees of the Long Island are authority for a tale of unorthodox foraging for locomotive fuel. It seems that in removing the Pennsylvania's replica of the "John Bull" locomotive (1831) from the late New York World's Fair, where it appeared in "Railroads on Parade," it was decided to run it under its own power over the busy tracks of the Long Island to the Morris Park shops, where it was to be prepared for shipment to Chicago to appear in a forthcoming celebration in connection with the installation of the big "S-1" locomotive in regular service. The antique unit took some 4½ hours for the run of approximately eight miles and reached its destination at 4:30 p. m., just before the rush of outbound commuters' trains began.

First trouble was encountered at Forest Hills—right on the busy multiple-track main—when the fire "died." Wood commandeered from a nearby grocery store put life into her again. Then several miles farther the fire languished again and the employees in charge, anxious about the impending "rush hour," ransacked a dairy plant along the line for old boxes, which, we learn, saved the day.

V. R. Hawthorne Honored at St. Louis

At the dinner and meeting of the Car Department Association of St. Louis, held Tuesday evening, November 19, at the Hotel De Soto, St. Louis, Mo., V. R. Hawthorne, secretary, Association of American Railroads, Mechanical Division, was the guest of honor and made the principal address.

At the conclusion of Mr. Hawthorne's address, F. E. Cheshire, president of the Car Department Association of St. Louis and general car inspector, Missouri Pacific, complimented the author on his effective

Plaque presented to V. R. Hawthorne on November 19 by the Car Department Association of St. Louis

work in co-ordinating the activities of the various A. A. R. committees, especially those having to do with the more efficient interchange of railway freight equipment. In the name of the association, Mr. Cheshire presented Mr. Hawthorne with a bronze plaque inscribed "Awarded to V. R. Hawthorne, November 19, 1940, in recognition of his incomparable contribution to the mechanics of railroad transportation, a patient counsellor, a gracious gentleman. Car Department Association of St. Louis, Mo."

Orders and Inquiries for New Equipment Placed Since the Closing of the December Issue

Locomotive Orders

Road	No. of Locos.	Type of Locos.	Builder
Aluminum Co. of America	1	350-hp. Diesel-elec.	General Elec. Co.
Arkansas Valley	2	350-hp. Diesel-elec.	General Elec. Co.
Atchison, Topeka & Santa Fe	1	1,000-hp. Diesel-elec.	Baldwin Loco. Works
Bessemer & Lake Erie	5[1]	2-10-4 Texas-type	Baldwin Loco. Works
	2[1]	0-8-0	American Loco. Co.
Boston & Maine	4	380-hp. Diesel-elec.	General Elec. Co.
	2	4-8-2	Baldwin Loco. Works
E. I. duPont de Nemours Co.	1	350-hp. Diesel-elec.	General Elec. Co.
	2[2]	300-hp. Diesel-elec.	....
	2[3]	300-hp. Diesel-elec.	....
East Erie Commercial	1	350-hp. Diesel-elec.	General Elec. Co.
Elgin, Joliet & Eastern	7	600-hp. Diesel-elec.	Electro-Motive Corp.
	2	1,000-hp. Diesel-elec.	
	3	600-hp. Diesel-elec.	American Loco. Co.
	2	1,000-hp. Diesel-elec.	
	1	1,000-hp. Diesel-elec.	Baldwin Loco. Works
Great Northern	2	2,700-hp. Diesel-elec.	Electro-Motive Corp.
Gulf, Mobile & Ohio	4	660-hp. Diesel-elec.	American Loco. Co.
Jones & Laughlin Steel Corp.	1	Freight	American Loco. Co.
Kewanee, Green Bay & Western	1	660-hp. Diesel-elec.	American Loco. Co.
Monongahela Connecting	2	750-hp. Diesel-elec.	General Elec. Co.
Mississippi Export	1[4]	380-hp. Diesel-elec.	General Elec. Co.

Orders and Inquiries for New Equipment—Continued

New York, New Haven & Hartford	1	380-hp. Diesel-elec.	General Elec. Co.
Norfolk & Western	5	4-8-4 Pass.	Company Shops
Northeast Oklahoma	1	500-hp. Diesel-elec.	General Elec. Co.
Northern Pacific	8	4-8-4	Baldwin Loco. Works
	6	4-6-6-4	American Loco. Co.
Pittsburgh Limestone Corp. (U. S. Steel subsidiary)	5	320-hp. Diesel-elec.	General Elec. Co.
Reading	4	600-hp. Diesel-elec.	Electro-Motive Corp.
	1	1,000-hp. Diesel-elec.	
	3	600-hp. Diesel-elec.	Baldwin Loco. Works
	3	1,000-hp. Diesel-elec.	
	3	660-hp. Diesel-elec.	American Loco. Co.
Republic Steel Corp.	2[2]	340-hp. Diesel-mech.	Fate-Roat-Heath Co.
	1	340-hp. Diesel-mech.	
Semmett-Solvay Co.	2	500-hp. Diesel-elec.	General Elec. Co.
St. Louis-San Francisco	3[5]	4-8-4 Pass.	Company Shops
	5[6]	4-8-2 Freight	
Southern	2	4,000-hp. Diesel-elec.	Electro-Motive Corp.
	2	4,000-hp. Diesel-elec.	American Loco. Co.
United States Army	2	350-hp. Diesel-elec.	General Elec. Co.
	1	300-hp. Diesel-elec.	
	2[3]	Diesel-elec.	
Wabash	1	600-hp. Diesel-elec.	Electro-Motive Corp.
Youngstown Sheet & Tube Co.	1	Steam	Heiseler Loco. Works

LOCOMOTIVE INQUIRIES

Panama Railroad[7]	3	Steam	
Union Pacific	5, 10 or 15	Freight	
United States Navy Dept.	1	50-ton Diesel-elec.	

FREIGHT-CAR ORDERS

Road	No. of Cars	Type of Cars	Builder
Aliquippa & Southern	25	90-ton gondola	Company Shops
Berwind-White Coal Mining Co.	50	50-ton hopper	Company Shops
Bessemer & Lake Erie	650[1]	90-ton hopper	Pull-Std. Car Mfg. Co.
	300[1]	50-ton box	Greenville Steel Car Co.
	50[1]	50-ton flat	Magor Car Corp.
	100[8]	Box	American Car & Fdry. Co.
	20[8]	Caboose	Greenville Steel Car Co.
Colorado & Wyoming	15	70-ton gondola	Pull-Std. Car Mfg. Co.
Cudahy Car Lines	50	40-ton refrigerator	Company Shops
Detroit, Toledo & Ironton	300	50-ton gondola	Greenville Steel Car Co.
Erie	50	70-ton flat	Greenville Steel Car Co.
Ethyl Gasoline Corp.	18	50-ton tank	American Car & Fdry. Co.
	6	40-ton tank	
Illinois Terminal	250	Box	American Car & Fdry. Co.
International Nickel Co. of Canada	15	70-ton ore	National Steel Car Co
Louisville & Nashville[9]	50	70-ton gondola	Pull.-Std. Car Mfg. Co.
	1,400	50-ton hopper	American Car & Fdry. Co.
	1,600	50-ton hopper	Pull-Std. Car Mfg. Co.
	50	70-ton gondola	
	100	Box	
Ministry of Transp. and Public Works, Brazil	150	30-ton flat	Pull-Std. Car Mfg. Export Co.
	150	30-ton box	
	150	30-ton gondola	American Car & Fdry. Export Co.
	8	30-ton tank	
	150	Sets of trucks	
New York Central	200	70-ton flat	Despatch Shops, Inc.
Norfolk & Western	30	70-ton hopper	Company Shops
Northern Pacific	30[4]	70-ton hopper	Gen. Amer. Transp. Corp.
Norfolk Southern	250	40-ton box	Magor Car Corp.
	50	50-ton gondola	American Car & Fdry. Co.
	50	50-ton hopper	Virginia Bridge Co.
Panama Railroad	35	50-ton flat	Magor Car Corp.
	30	50-ton box	
	15	Gondola	
Pittsburgh & West Virginia	20[4]	Caboose	Company Shops
St. Louis-San Francisco	500	40-ton box	Company Shops
	100[10]	Coal	
	9[10]	Box	
	1[10]	Automobile	
	10[10]	Caboose	
Solvay Process Co.	5	70-ton tank	American Car & Fdry. Co.
	4	40-ton tank	
Southern Pacific	125	70-ton flat	Southern Pacific Equip. Co.
	15	70-ton gondola	
	50	Caboose	
Tennessee Central	100	40-ton box	Pull.-Std. Car Mfg. Co.
Union Tank Car Co.	150[11]	50-ton tank	Company Shops
Wabash Car & Equipment Co. of St. Louis	5	70-ton hopper	American Car & Fdry. Co.

FREIGHT-CAR INQUIRIES

Chicago, Indianapolis & Louisville	100	50-ton box	
	100	50-ton flat	
Elgin, Joliet & Eastern	500	50-ton box	
Pittsburgh & Lake Erie	1,000	Box	

PASSENGER-CAR ORDERS

Road	No. of Cars	Type of Cars	Builder
Atlanta & West Point Western Railway of Alabama	2	Baggage-express	American Car & Fdry. Co.
Canadian Pacific	25	Passenger-train	Company Shops
	10	Baggage and express	Canadian Car & Foundry Co.
Pacific Electric	30[4]	Coaches	Pull-Std. Car Mfg. Co.

[1] Has awarded contracts for the construction amounting to approximately $5,000,000. See December issue.
[2] Delivered in November, 1940.
[3] Delivered earlier this year.
[4] Delivery received.
[5] For delivery March, 1941.
[6] For delivery June, 1941.
[7] Bids will be received to December 30 by the general purchasing officer, the Panama Canal, Washington, D. C.
[8] Contracts for this equipment amounting to approximately $475,000.
[9] Estimated cost of this equipment is $7,527,271.
[10] Constructed earlier this year.
[11] For completion in March, 1941.

Painted Wheels and Car Retarders

THE Association of American Railroads, Mechanical division, reports in a circular letter from Secretary V. R. Hawthorne, dated December 5, that some difficulty is being experienced in controlling cars (especially when loaded) through car retarder devices in cases where the wheels have been newly painted. The Arbitration Committee has ruled that resulting damage to cars, where no failure of the retarder itself, or its method of operation, is involved, shall be the responsibility of the car owner, provided a Rule 44 combination is not reached. The committee suggests that member roads make arrangements to protect both the outside and inside surfaces of wheel rims by metal shields or other device while trucks are being painted.

Retirement Board Names Employment Officers

ANNOUNCEMENT of the appointment of nine employment officers to administer the recently-established employment service was made on December 2 by the Railroad Retirement Board. The employment service, it is pointed out, is being operated in connection with the railroad unemployment insurance system, and makes possible the collection in each regional office of the Board of a complete file of unemployed railroaders in the region. Names and qualifications of the idle railroad workers are referred on request to railroad employers for interview and placement.

Those named to the new positions and their regions include: Peter S. Hogan, New York region; John J. Finnerty, Cleveland; Horace L. Carter, Chicago; James H. Williams, Atlanta; John R. Duck, Minneapolis; Otto Kirkes, Kansas City; Sam J. Williams, Dallas; Earl F. Rentfrow, Denver; and Harold O. Clark, San Francisco. Most of the appointees have had railroad experience, and all have been associated with the Railroad Retirement Board.

Equipment Depreciation Orders

EQUIPMENT depreciation rates for 11 railroads, including the Louisville & Nashville and the Kansas City Southern, have been prescribed by the Interstate Commerce Commission in a new series of sub-orders and modifications of previous sub-orders in No. 15100, Depreciation Charges of Steam Railroad Companies. The composite percentages for all equipment, which are not prescribed rates, range from 3.01 per cent for the L. & N. to 9.41 per cent for the Angelina & Neches River.

Prescribed rates for the L. & N. are as follows: Steam locomotives, 2.83 per cent; other locomotives, 3.92 per cent; freight-train cars, 3.08 per cent; passenger-train cars, 2.62 per cent; work equipment, 3.92 per cent; miscellaneous equipment, 13.03 per cent. The K. C. S. composite percentage is 3.07, derived from prescribed rates as follows: Steam locomotives, 3.18 per cent; other locomotives, 3.92 per cent; freight-train cars, 2.92 per cent; passenger-train cars, 3.05 per cent; work equipment, 3.03 per cent; miscellaneous equipment, 13.35 per cent.

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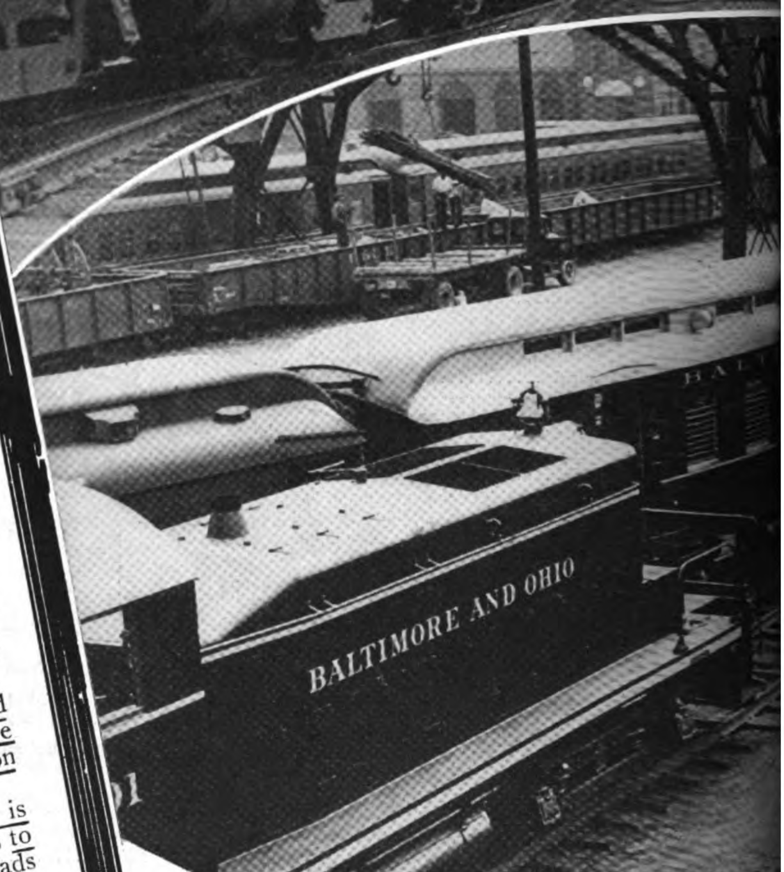
The



Controlling Switching Movements

In yard switching, the Diesel-electric locomotive gives very good service. My observations cover all classes of yard work: heavy lead switching, industry work, and transfer work.

The yardmen and enginemen soon become familiar with the handling of the Diesel locomotive. We all know the yardmen working with steam power, switch cars by the exhaust of the engine. The Diesel locomotive changes this, and the yardmen have to watch the cars, however, the proper handling is soon learned.

The yard engineman can save at least 20 per cent in the stopping distance, if the yardmen are out far enough from the side of the cars to be observed, so the engineman can use one hand on the throttle and the other hand on the brake valve. If the engineman is only using one hand to handle first the throttle and then the brake valve, they will move two or three car lengths farther before the cars separate. The Diesel locomotives drift as good or better than the cars. This is not the case with a steam locomotive, for when it is shut off the pistons act as a brake and will pull the slack out before the brakes are set on the steam locomotive.

Diesel engines come up to their maximum speed within a few seconds and there is available full tractive force through the electrical system. Quick acceleration results. Standby losses are small.

Yardmen favor the Diesel locomotive because there is no exhaust steam or smoke blowing down on the leads to interfere with their signals, nor ice forming on the leads in the winter from the injector overflow. The engine crew's visibility is very good, and this is a very important factor in a busy terminal where a large number of trains, engines, and signals must be observed.

Yardmasters can place the Diesel locomotives on any job. There is no need to think of the wheel arrangement, or the road number when the smaller old industry tracks have to be pulled or a car spotted. The Diesel will go any place a freight car will clear. The Diesel locomotive will also make transfers, making it unnecessary for the yardmaster to wait until a certain type locomotive returns from another job to make the delivery. It will go out on a lead and give very good service. The Diesel locomotive is ideal yard power.

From Leo W. Powell's paper "The Road Foreman and the Diesel-Electric Locomotive" presented at the fourth annual meeting of the Railway Fuel and Traveling Engineers' Association.

Mediation Board Decision on Lehigh Valley

THE National Mediation Board has decided that certain employees who have worked for the Lehigh Valley during the period from January 1, 1940, to September 16, 1940, although they may now be on furloughs, are entitled to vote in an election to determine which of two unions shall represent a particular class of employees in collective bargaining.

The decision of the board on December 8 reveals that its services were invoked by the Railway Employees' Department, American Federation of Labor, to settle a dispute as to whether the International Brotherhood of Blacksmiths, Drop Forgers and Helpers, the International Brotherhood of Boilermakers, Iron Ship Builders and Helpers of America and the Sheet Metal Workers' International Association, operating through the Railway Employees' Department, A. F. of L., may represent, respectively, the blacksmiths, boilermakers and sheet metal workers and the helpers and apprentices of the foregoing, employed by the Lehigh Valley.

Mediator James P. Kiernan found, after investigation, that the employees involved in the dispute are at present represented by the Association of Maintenance of Equipment Employees of the Lehigh Valley.

The board goes on to point out that it is the position of the Association that the list of eligible voters should contain only the names of employees who were on the payroll of the carrier as of the last of the month of September, 1940, including men now in service, those on authorized leaves of absence, those on sick leave, those on the injured list, and those who had been in the services of the company on the above date but had left to enlist in the United States Army or Navy. The Railway Employees' Department contends on the other hand that the list of eligible voters should contain those names which appeared on the payroll for the last period of September, 1940, including those on sick leave, or other authorized leave of absence and those who have worked for the carrier during the period from January 1, 1940, to September 16, 1940, and who were then on furlough on account of reductions in force.

The Board decided to use the January 1, 1940, date because of the fact that in another election involving, among others, these same employees, it had used this date. After the election had got under way the Association protested this action and asked for the public hearing held on November 25 before Board Member D. J. Lewis.

After testimony of both the employees and J. P. Laux, superintendent of motive power of the Lehigh Valley, to the effect that it was the established policy of the carrier to recall furloughed employees to service when forces are increased and that furloughed employees retain their seniority rights, the Board decided to abide by its previous finding and permit the election to be held at some future date. The votes already cast will be allowed in the new election.

Supply Trade Notes

GALE E. SPAIN has been appointed general sales manager of the Caterpillar Tractor Company.

◆

JAY M. REIBEL, formerly with McCann-Erickson, has been appointed advertising manager of the American Car and Foundry Company.

◆

SHIRLEY, OLCOTT & NICHOLS have been appointed sales representatives for government work by the Whiting Corporation, Harvey, Ill. Offices are at 202 Mills Building, Washington, D. C.

◆

P. C. CADY has been appointed district sales representative of the Union Railway Equipment Company, Chicago, with headquarters at 30 Church street, New York.

◆

PAUL KELLER has been appointed Cleveland district manager in charge of the sale of Aristoloy alloy steels by the Copperweld Steel Company with offices in 415 Swetland Building, Cleveland, Ohio. Mr. Keller was previously connected with the Mid-States Steel & Wire Co. and the Bethlehem Steel Company.

◆

THE A. M. BYERS COMPANY, Pittsburgh, Pa. will soon enlarge its activies to include the production of alloy steels, including stainless. An addition will be built to the company's Ambridge plant and will be used as a melt shop for new electric furnace equipment. Other existing basic production equipment for heating and rolling alloys will be used. The production of billets and bars for alloy-steel fabricators will begin in four to six months.

◆

JAMES F. FITZGERALD has been appointed special representative on railway welding requirements by the C. D. Hicks Company of St. Louis, Mo., which company has been designated sales agent to railways operating in the St. Louis area on Universal arc and spot welders, accessories, rods and electrodes manufactured and for sale by the Universal Power Corporation of Cleveland, Ohio.

◆

ALEXANDER D. BRUCE, vice-president and secretary of the Vapor Car Heating Company, Inc., Chicago, has been elected executive vice-president, and Otis A. Rosboro, a director, has been elected secretary. Mr. Bruce was born in Guelph, Canada, in 1887. His early employment was with a large carriage manufacturing plant and with the Standard Fitting & Valve Company in Canada. In 1909 he entered the employ of the Chicago Car Heating Company as storekeeper, and was successively purchasing agent and later Canadian manager. In 1917, upon the organization of the Vapor Car Heating Company, Inc., Mr. Bruce was elected secretary. In 1926, he was elected a director and vice-president and secretary of the Vapor Car Heating Company.

Alexander D. Bruce

◆

A. B. MOREY, treasurer of the Gisholt Machine Company, Madison, Wis., has been elected vice-president and C. K. Swafford, general superintendent, has been elected a director.

◆

FOREMAN H. CRATON has been appointed section head of the industrial haulage section of the General Electric Company's transportation department at Erie, Pa. Mr. Craton has been with General Electric since 1924, where he has spent about four years on the design of railway motors and control and also been identified with important work on the New York Central, Cleveland Union Terminal, and New York, New Haven & Hartford electrifications, and more recently on industrial and railway applications of Diesel-electric locomotives. He is a mechanical engineer, graduate of Syracuse University, a member of the American Institute of Electrical Engineers, past chairman of the Erie section, and has presented several papers before the national body.

◆

JOHN M. SPANGLER, general sales manager of the National Carbon Company, has been appointed a vice-president of that company. Mr. Spangler, a graduate of Pennsylvania State College, joined the National Carbon Company in 1915. He became manager of the Railroad department five years later and in 1923 was made head of the Western Sales division with headquarters in Chicago. He became successively manager of the Eastern division with offices in New York, assistant general sales manager and in 1925 general sales manager.

(*Turn to second right-hand page*)

Obituary

Tom Moore, representative at Norfolk, Va. for the Gold Car Heating & Lighting Co., died on October 30.

◆

F. B. Hamerly, vice-president of the Independent Pneumatic Tool Company of Chicago, died November 27, of a heart attack, while inspecting the company's plant at Los Angeles, Calif.

◆

William S. Hamm, consulting engineer and a director of the Adams & Westlake Company, with headquarters in Elkhart, Ind., died in Denver, Colo., on December 1. He had been in the employ of the company 61 years.

◆

William Miller, chairman of the board of the Pyle-National Company, Chicago, died in that city on December 4, after a long illness. Mr. Miller was born at Hannibal, Mo., on July 3, 1867, and entered railway service as an apprentice in the Hannibal shops of the Chicago, Burlington & Quincy in June, 1882. From 1885 to 1889, he served as a journeyman on the Missouri-Kansas-Texas, the Wabash and the Denver & Rio Grande Western. In the latter year, he was appointed foreman of shops on the St. Louis San Francisco, and

William Miller

in 1900 became general foreman of the Colorado Midland. In 1904-05 he was appointed master mechanic of the Terminal Railroad Association and the Wiggins Ferry of St. Louis, and for two years was master mechanic and assistant superintendent of the Denver & Rio Grande Western. In 1907, Mr. Miller became superintendent of motive power of the Western Maryland and in 1908 resigned to become vice-president of the Adreon Manufacturing Company. Three years later he was elected president of the Monarch Pneumatic Tool Company and vice-president of the Standard Railway Equipment Company, from which position he resigned in 1913 to become vice-president of the Pyle-National Company. In 1914, he was elected senior vice-president, on August 2, 1934, president, and in March, 1938, chairman of the board.

◆

H. C. Dreibuss, chief mechanical engineer of the Scullin Steel Company, died November 22, at St. Louis, Mo. Mr. Dreibuss had been with the Scullin Steel Company for 34 years.

Personal Mention

General

E. A. Shull, superintendent of motive power of the Wichita Falls & Southern, with headquarters at Wichita Falls, Tex., has retired. The position of superintendent of motive power has been abolished.

William Nelson, superintendent of machinery of the Kansas City Southern, has been appointed also superintendent of machinery of the Louisiana & Arkansas, with headquarters as before at Pittsburg, Kan.

E. M. Smith, superintendent of motive power of the Louisiana & Arkansas, has been appointed assistant superintendent of machinery of the Kansas City Southern and the Louisiana & Arkansas, with headquarters as before at Minden, La.

Master Mechanics Road Foreman

J. C. Benson, general foreman of the Atlantic Coast Line at Jacksonville, Fla., has been appointed master mechanic at Jacksonville.

H. J. Cosgrove, general enginehouse foreman on the Chicago, Rock Island & Pacific at Silvis, Ill., has been promoted to the position of master mechanic at Fairbury, Neb.

R. E. Deitrich, master mechanic of the Chicago, Rock Island & Pacific with headquarters at Dalhart, Tex., has been transferred to Armourdale, Kan., succeeding G. W. Heyman, who retired on December 1, after 34 years' service.

W. W. Lyons, general foreman on the Atchison, Topeka & Santa Fe at Belen, N. M., has been promoted to master mechanic of the Slaton division of the Panhandle & Santa Fe, with headquarters at Slaton, Tex., succeeding L. E. Fletcher, who retired on December 1.

T. P. Maroney, master mechanic of the Chicago, Rock Island & Pacific at Fairbury, Neb., has been transferred to Dalhart, Tex.

T. F. Lake has been appointed master mechanic of the Nevada Northern, with headquarters at East Ely, Nev., succeeding Charles Nesbitt, deceased.

Car Department

De Wyatt Akins, who has been appointed superintendent of the car department of the Texas & Pacific at Dallas,

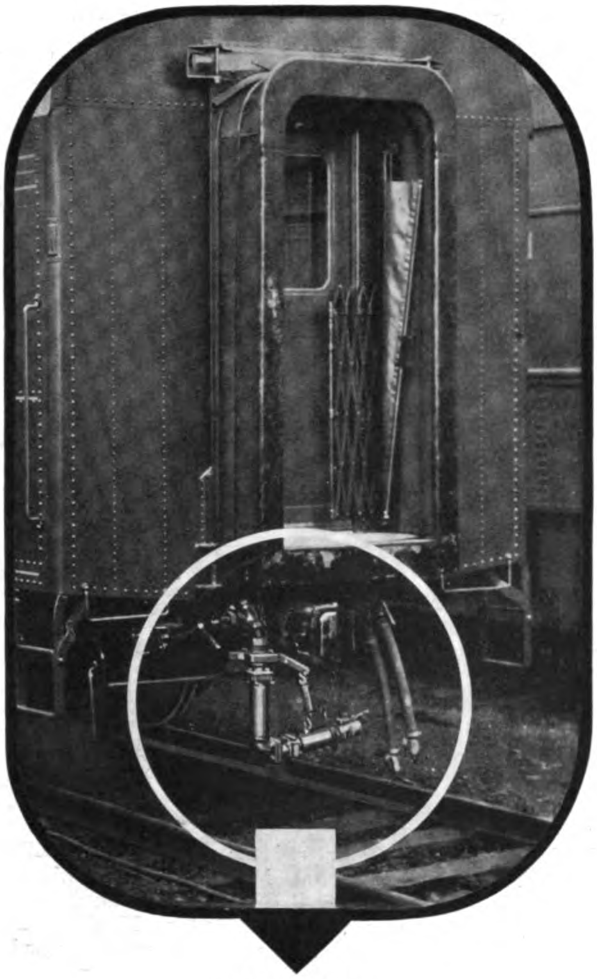
DeWyatt Akins

Tex., as noted in the October issue, was born on July 15, 1881, at Oxford, Miss. He attended the public schools and during 1899 entered the employ of the Illinois Central at Memphis, Tenn., where he served until 1904 as an apprentice, a car repairer, and an inspector. He then went to Shawnee, Okla., as a car repairer and inspector on the Choctaw, Oklahoma & Gulf. During 1906 he was a car inspector on the Union Railway at Memphis, Tenn., later being promoted to the position of foreman of the car department. In 1917 he became general car foreman on the Texas & Pacific at Fort Worth, Tex., and in 1932 was appointed general car department foreman at Marshall, Tex. In 1933 he became general car inspector, with jurisdiction over all T. & P. Lines. He was appointed superintendent of the car department at Dallas on August 1, 1940.

R. H. Marquart, superintendent of the freight-car department of the Illinois Terminal, has been transferred from Decatur, Ill., to St. Louis, Mo.

Obituary

Ora Clair Montgomery, whose death was noted in the December issue, was born on March 29, 1884, at Scribner, Neb., and entered the service of the New York Central in June, 1916, as a tester in the engineering department. He was appointed a special engineer the following year and in May, 1918, was given a leave of absence to enter the Army, in which he was commissioned a first lieutenant, United States Engineers. In January, 1919, he returned to railroad service as a computer and was appointed an engineer in the power department the following month. In July, 1921, he was appointed special staff engineer, power department, electric division, and in May, 1926, became assistant superintendent of power.



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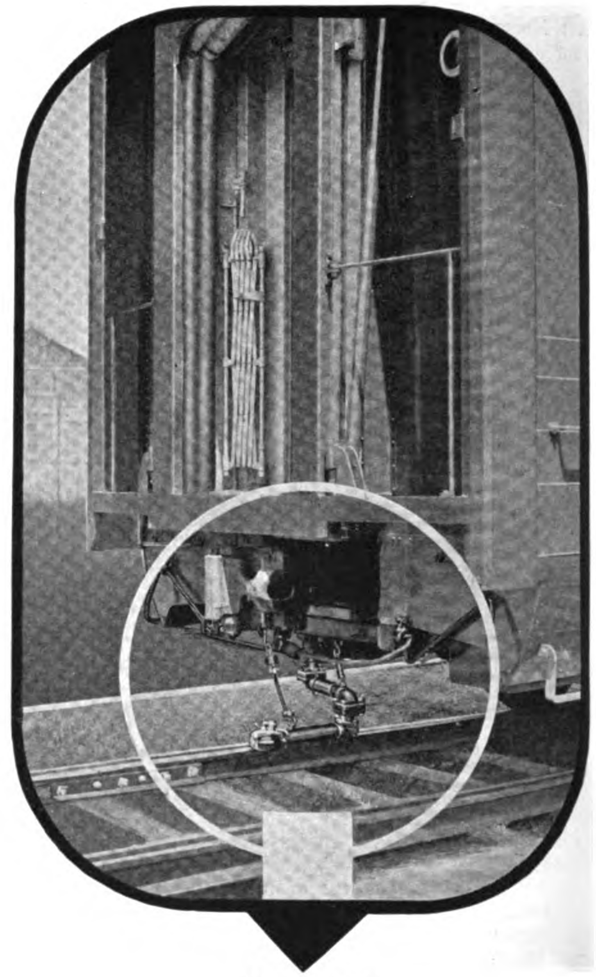

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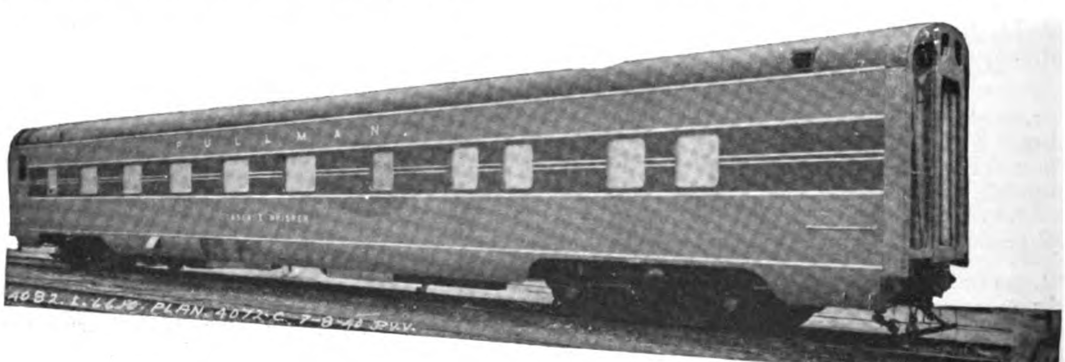
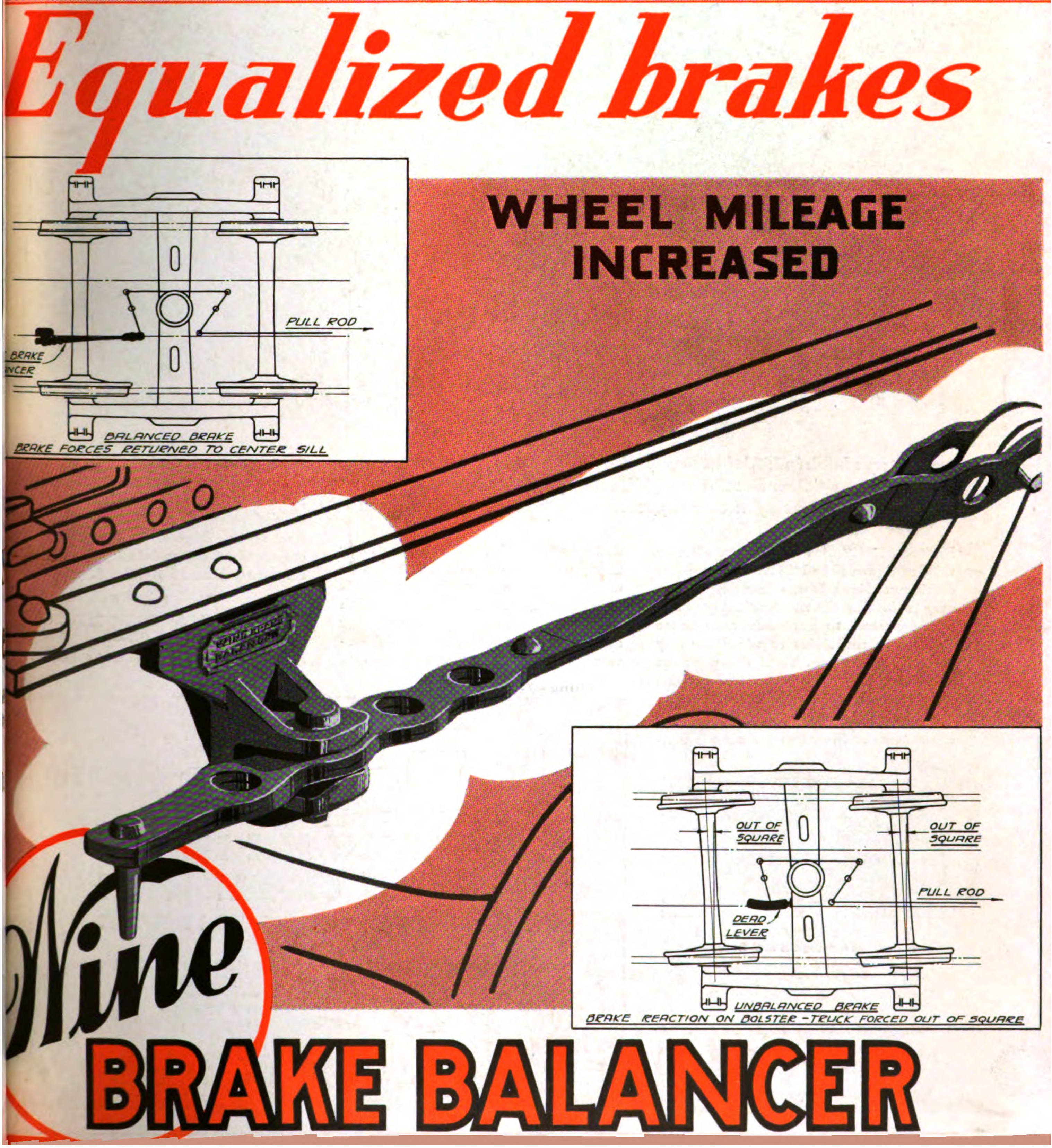


Railway Mechanical Engineer

February
1941

FOUNDED IN 1832



The Well Earned Privilege of Leadership

It was back in 1933 that Dayton introduced the first successful V-Belt Gear Box Drive which contributed so much to the advancement of modern passenger car air conditioning.

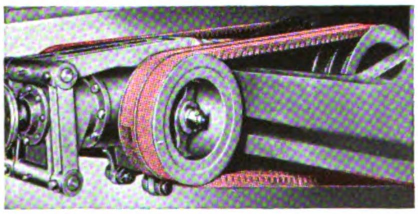
Dayton "D-R" 2" V-Belts were already tried and proved in 1933 as a dependable driving medium. It was then only necessary to develop the mechanical gear box arrangement to accommodate these V-Belts in multiples required for any capacity generator. Then the problem of driving the large generators needed for air conditioning was solved.

Dayton's contribution to the amazing advancement in passenger car air conditioning since 1933 is just one of our many achievements during a decade of pioneering and perfecting V-Belt Axle Drives . . . achievements which have kept us busy and happy staying abreast of the great railroads' developments in luxury equipment.

This constant challenge to our ability and resourcefulness has been to us—not the penalty—but the well earned privilege of leadership which has made Dayton Drives the one standard of dependability by which all others must be judged.

* * *

THE DAYTON RUBBER MFG. CO.
DAYTON, OHIO
Pioneers of Railway V-Belts and Connectors



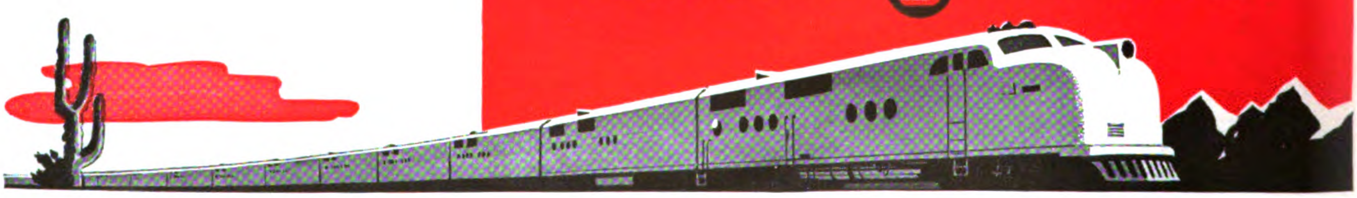
Dayton "D-R" 2" V-Belt Axle Drives applied to a gear box operating a 15 K.W. Generator.

Dayton

"D-R" V-BELT AXLE DRIVES AND ENDLESS COG-BELT DRIVES

FOR CAR-LIGHTING AND AIR-CONDITIONING EQUIPMENT

MADE BY THE WORLD'S LARGEST D MANUFACTURER OF V-BELTS



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February, 1941

Volume 115 *No. 2*

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RAILWAY MECHANICAL ENGINEER

Western Maryland Buys

4-6-6-4 Type Locomotives

Baldwin Locomotive Works now delivering 12 articulated locomotives which develop 95,500 lb. tractive force, have 5,770 sq. ft. of combined heating surface, and 118.8 sq. ft. grate area—These locomotives are replacing 2-10-0 type between Hagerstown and Connellsville

DELIVERIES of 12 4-6-6-4 single-expansion articulated freight locomotives are now being made to the Western Maryland by the Baldwin Locomotive Works. These locomotives are going into service between Hagerstown, Md., and Connellsville, Pa., a line 171.4 miles long. These locomotives develop 95,500 lb. tractive force, with driving wheels 69 in. in diameter. They have a combined heating surface of 5,770 sq. ft. and carry a working pressure of 250 lb. per sq. in. The four cylinders are 22 in. diameter by 32 in. stroke.

The line over which the new locomotives will operate is one of severe grades, particularly in the westerly direction. From Hagerstown 103 miles west to the summit of a 23-mile grade of 1.75 per cent, there is a difference of elevation of about 2,875 ft. Eastbound from Connellsville the grade is not so severe. It is a steady climb, however, ending with 13 miles of 0.8 per cent grade, and there is a difference of elevation between Connellsville and the summit of over 2,100 ft. in about 68 miles. Approaching Hagerstown there is 7 miles of 1.1 per cent ascending grade.

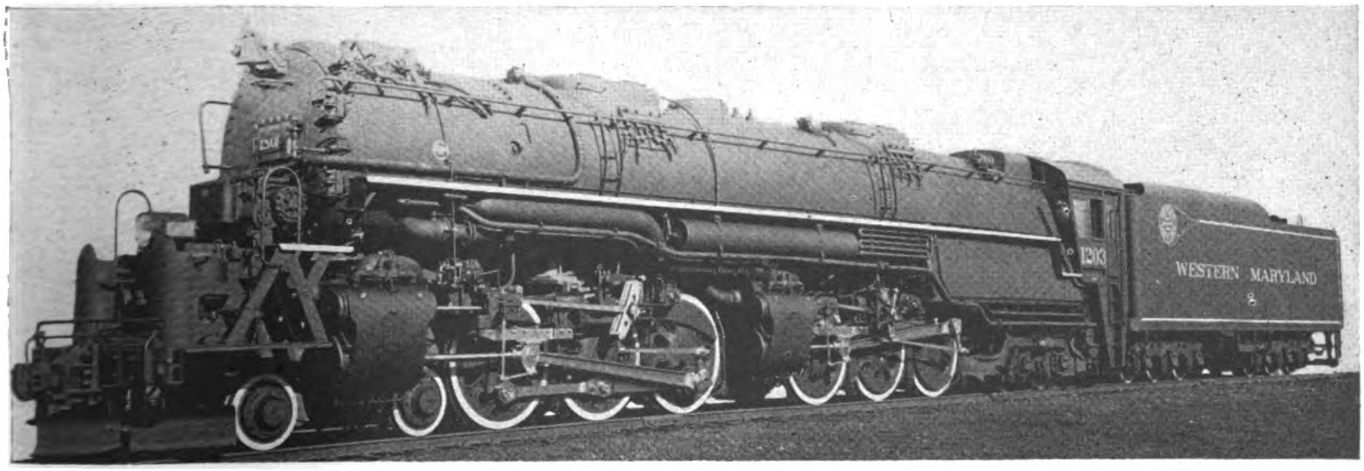
The Boiler

There are several points of interest in the design of the boilers of these locomotives. The firebox is of unusually large dimensions and is supplemented by a 96-in. combustion chamber. There are three Duplex type Thermic syphons in the firebox and two single-connection syphons in the combustion chamber. The front tube sheet is of two-piece welded construction, riveted in the boiler.

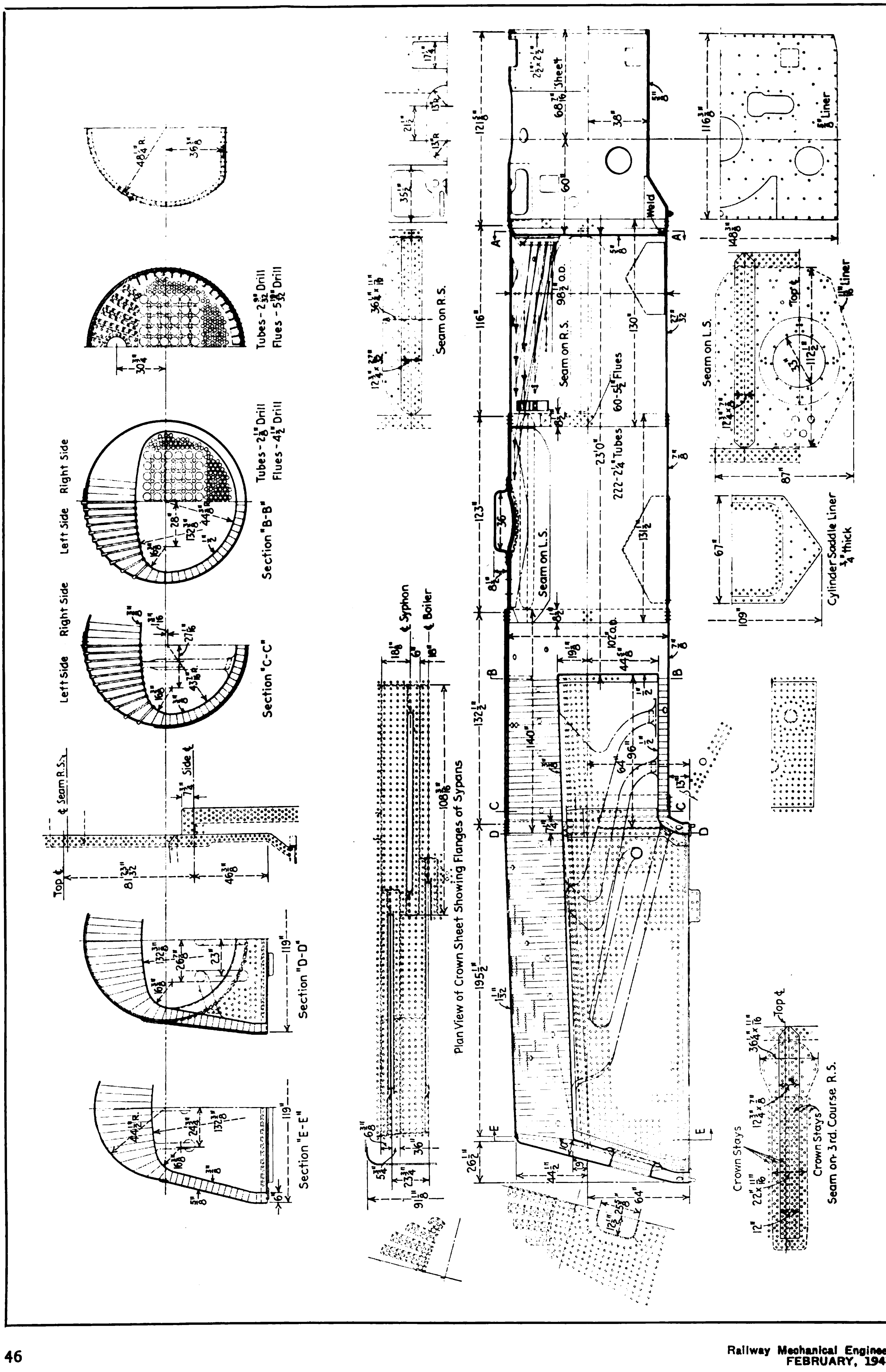
The boiler is straight-top in form with three barrel courses. The barrel and wrapper sheets are of silico-manganese steel. The tubes and flues have a copper content of 0.20 per cent. The inside dimensions at the mud ring are 17 ft. 8⅛ in. by 8 ft. 10¼ in. From the top of the door sheet to the flue sheet the crown sheet is 24 ft. 3⅝ in. in length. Over the front end of this sheet is a Barco low-water alarm.

The grate area is limited to 118.8 sq. ft. by the insertion of a Gaines wall which cuts off at the front end about 4 ft. 3 in. of the length inside the mud ring. This area is closed with a plate and stiffening angles.

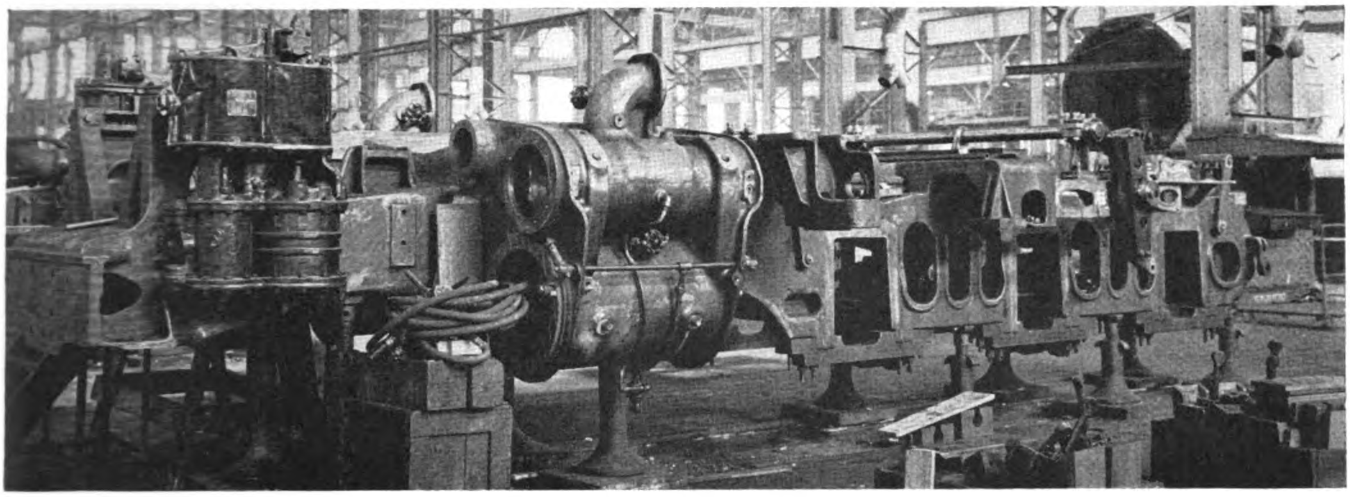
Each of the Duplex Thermic syphons in the firebox has two connections to the water space. All of the rear connections are through the throat sheet. The forward connection of the middle syphon is through the bottom of the combustion chamber; that of each side syphon is through the side sheet of the firebox. The combustion-chamber syphons, which alternate in lateral spacing with



Western Maryland articulated freight locomotive built by Baldwin



Longitudinal and cross sections of the boiler of the Western Maryland articulated locomotive



Assembling the front engine unit

those in the firebox, connect through the bottom of the combustion chamber.

The firebox and combustion chamber are of welded construction. The flange of the firebox tube sheet has a radius of 2 in. at the top, which is gradually reduced to ¾ in. opposite the top outside superheater flue. The firebox sheets are single riveted to the mud ring and the bottom edges of both the inside and outside sheets are seal welded all around.

The vertical wrapper-sheet seams are also seal welded 12 in. up from the bottom. Wherever the presence of the heads of expansion or flexible stays interferes with calking, the edges of the throat and wrapper sheets are also seal welded.

Another interesting application of welding is at the front tube sheet. This is in two parts—the tube sheet proper, which is a flat disc, and a separate rectangular ring in lieu of a flange. The ring is single riveted to the shell and against the inside edge is placed the tube-sheet disc. The latter clears the inside of the shell by ⅛-in. all around and is secured to the ring by a single vee-weld applied in the angle between the two pieces on the smokebox side.

A considerable expanse of flat surface on the front tube sheet beyond the boundaries of the tube layout is in itself unsupported against the boiler pressure partly because of the absence of the flange radius. This area is supported by gussets of ½-in. plate welded to the front of the tube sheet and to the tube-sheet ring. These gussets, of which there are three lengths to suit the distances between the outside tubes and the boiler shell, are shown in the tube-sheet layout as well as on one of the cross-sections of the locomotive.

Another noteworthy detail of the front tube sheet is the combination with the drypipe ring of the four center rows of tube-sheet brace lugs in a single steel casting. The usual tee-section attachments are applied for the three outside rows of braces on each side.

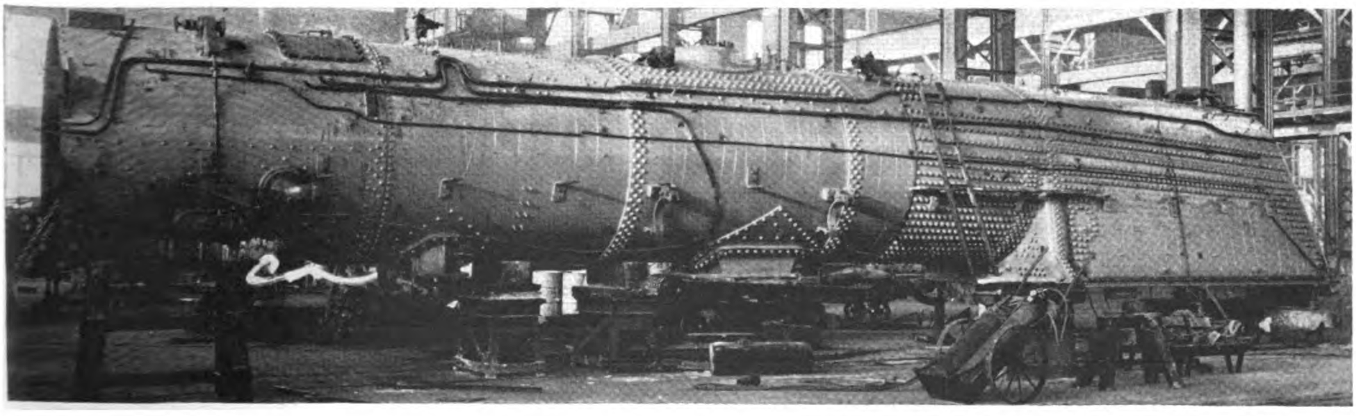
Aside from the first four transverse rows at the front, which are Alco expansion stays, the crown stays are threaded and riveted. Alco flexible stays are applied on the side, back head and throat sheets in the breakage zones and on the curve between crown and side sheets of the combustion chamber. Flannery flexible bolts are applied around the lower half of the combustion chamber.

The superheater is Type A with the American multiple throttle in the header. There is a Tangential steam dryer in the dome. The feedwater heater is the Worthington Type 6½ SA with a capacity of 14,000 gallons per hour. A Hancock Type KNL injector will supply up to 11,000 gallons an hour.

In the fireboxes are Hulson tuyere type grates. Coal is fired by the Standard HT type stoker with the engine mounted in the tender.

Running Gear

The foundation of the front and rear engines of this locomotive are Commonwealth steel bed castings. Cylinders and back cylinder heads are integral parts of these castings. The articulation hinge, located in the front end of the rear bed casting in line with the transverse center



One of the Western Maryland boilers in the erecting shop

line of the cylinders, is of the universal type. A separate hinge casting is pin connected about a horizontal axis at the rear end of the front bed casting and the vertical hinge-pin is fitted with a ball bearing in the hinge casting.

The boiler is supported on the rear unit at the cylinder saddle and at the front and back ends of the firebox. The front firebox supports are expansion shoes supported on the bed castings. The rear support is an expansion plate. On the front unit the weight of the boiler is transferred to the bed casting through a single sliding waist support, free to adjust itself longitudinally with boiler-expansion and contraction and to align itself without distortion under vertical oscillations of the engine bed.

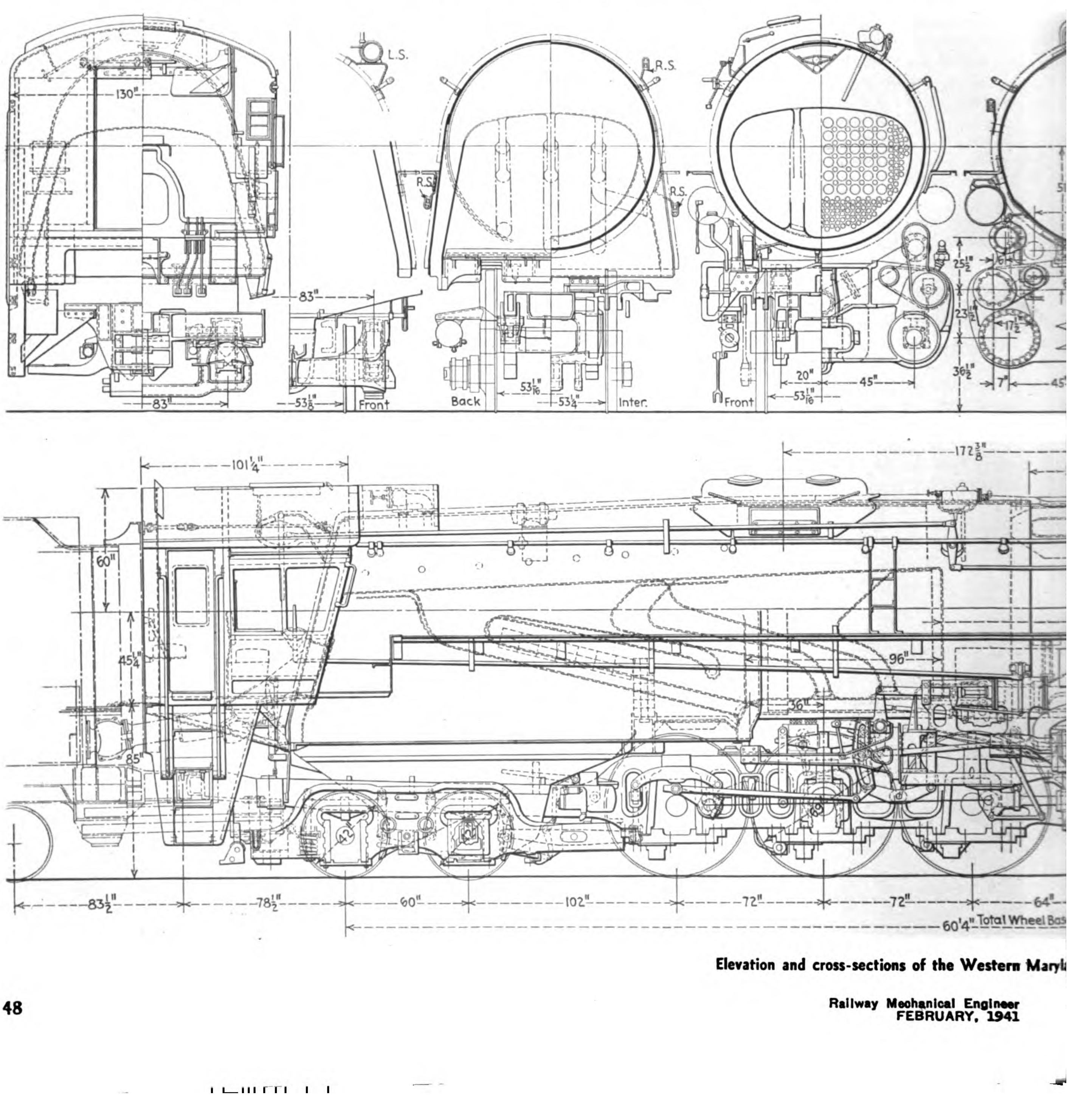
The driving wheels are Baldwin disc type of high-tensile steel. The driving journal boxes are cast steel with bronze crown bearings. The shoe-and-wedge fits and the hub faces of the driving box are bronze. The former are poured on, while the hub faces are ½ in. of welded metal. The driving-box wedges are Franklin compensators and snubbers.

The engine truck is a four-wheel Commonwealth design with inside bearings and rocker-supported swing bolster. The wheels and axles are A. S. F. roller-bearing units. The trailer truck is a Commonwealth four-wheel Delta type. The outside journal bearings are of bronze. Provision has been made so that boosters may be installed later.

Hennessy journal-box lubricators are installed in all driving boxes and trailing-truck boxes. The pump of the driving-journal lubricator is actuated by contact rods,

General Dimensions, Weights, and Proportions of the Western Maryland 4-6-6-4 Type Freight Locomotive

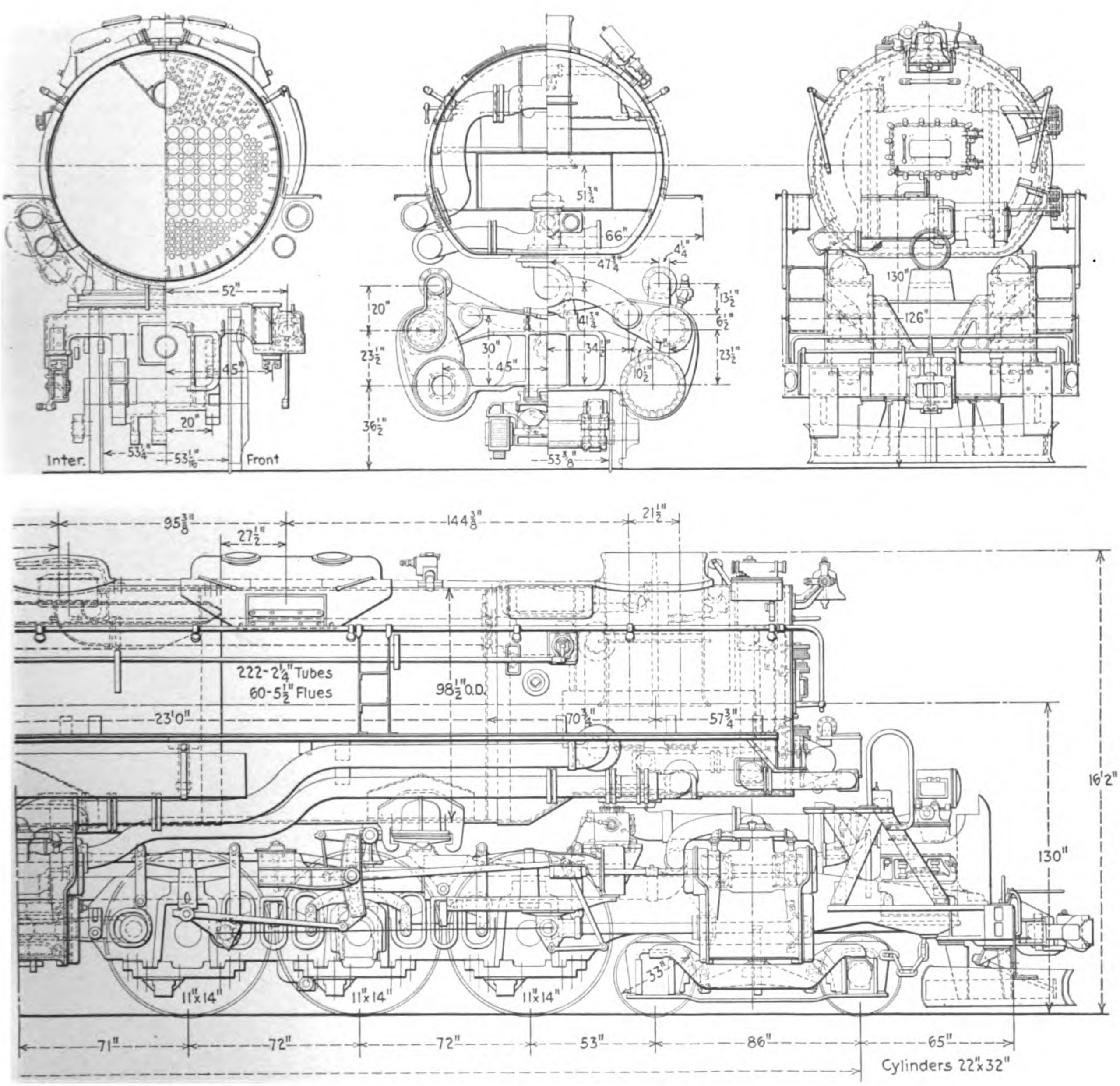
Railroad	Western Maryland
Builder	Baldwin
Type of locomotive	4-6-6-4
Road class	M-2
Road numbers	1201-1212
Date built	December, 1940
Service	Fast freight
Dimensions:	
Height to top of stack, ft.-in.	16- 2
Height to center of boiler, ft.-in.	10-10
Width overall, ft.-in.	11- 0
Cylinder centers, in.	90
Weights in working order, lb.:	
On drivers	402,266
On front truck	81,500
On trailing truck	117,234
Total engine	601,000
Tender (two thirds loaded)	338,250



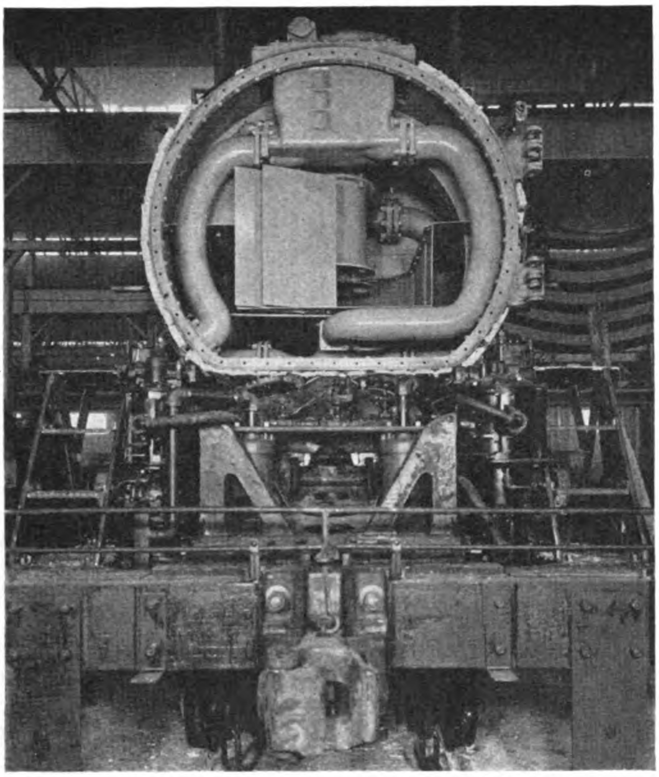
Elevation and cross-sections of the Western Maryl

Wheel bases, ft.-in.:	
Driving	35-3
Rigid	12-0
Engine, total	60-4
Engine and tender, total	106-0
Wheels, diameter outside tires, in.:	
Driving	69
Front truck	33
Trailing truck	42
Engine:	
Cylinders, number, diameter and stroke, in.	4-22x32
Valve gear, type	Walschaert
Valves, piston type, size, in.	12
Maximum travel, in.	7½
Steam lap, in.	1⅜
Exhaust clearance, in.	⅛
Lead, in.	6/16
Boiler:	
Type	Straight top
Steam pressure, lb. per sq. in.	250
Diameter, first ring, inside, in.	96 13/16
Diameter, largest, outside, in.	102
Firebox length, in.	212⅛
Firebox width, in.	106¼
Height mud ring to crown sheet, back, in.	72⅝
Height mud ring to crown sheet, front, in.	82¾
Combustion chamber length, in.	96
Thermic syphons, number	5
Tubes, number and diameter, in.	222-2¼
Flues, number and diameter, in.	60-5½
Length over tube sheets, ft.-in.	23-0
Fuel	Soft coal
Grate area, sq. ft.	118.8

Heating surfaces, sq. ft.:	
Firebox and comb. chamber	544
Thermic syphons	252
Firebox, total	796
Tubes and flues	4,974
Evaporative, total	5,770
Superheater	1,735
Combined evap. and superheat.	7,505
Tender:	
Type	Water bottom
Water capacity, gal.	22,000
Fuel capacity, tons	30
Trucks	Six-wheel
Journals, diameter and length, in.	7x14
Rated tractive force, engine, lb.	95,500
Weight proportions:	
Weight on driver ÷ weight engine, per cent	66.93
Weight on drivers ÷ tractive force	4.21
Weight of engine ÷ evaporation	104.16
Weight of engine ÷ comb. heat. surface	80.08
Boiler proportions:	
Firebox heat. surface, per cent comb. heat. surface.	10.61
Tube-flue heat. surface per cent comb. heat. surface.	66.28
Superheater heat. surface per cent comb. heat. surface	23.12
Firebox heat. surface ÷ grate area	6.70
Tube-flue heat. surface ÷ grate area	41.87
Superheater heat. surface ÷ grate area	14.60
Comb. heat. surface ÷ grate area	63.17
Evaporative heat. surface ÷ grate area	48.57
Tractive force ÷ grate area	803.87
Tractive force ÷ evaporative heat. surface	16.55
Tractive force ÷ comb. heat. surface	12.73
Tractive force × diameter drivers ÷ comb. heat. surface	878.01



4-6-6-4 type articulated locomotives for heavy, fast freight service



Feedwater heater and its steam connections—The double-stack extensions are shown in the background

the ends of which project beyond the end of the cellar and bear against the hub of the wheel. The pump keeps a distributing pad which bears against the under side of the journal flooded with oil while the locomotive is operating. The pump of the trailer journal lubricator is operated by arms, the ends of which bear against the end of the axle. This is the same method of operation employed in the A. A. R. type of lubricator used on the tender.

The piston heads are of forged steel and are fitted with Koppers American sectional cylinder packing of flanged cast-iron and bronze rings of the restrained type. The crosshead and guide have multiple bearing surfaces; the gib is of extruded aluminum. The main and side rods are annealed carbon steel. The side rods have heavy bronze bushings, pressed in. The front-end main-rod bushing is also fixed, while the rod connections on the main pins have floating bronze bushings running in fixed iron bushings. The knuckle pins are casehardened and fitted in casehardened steel bushings.

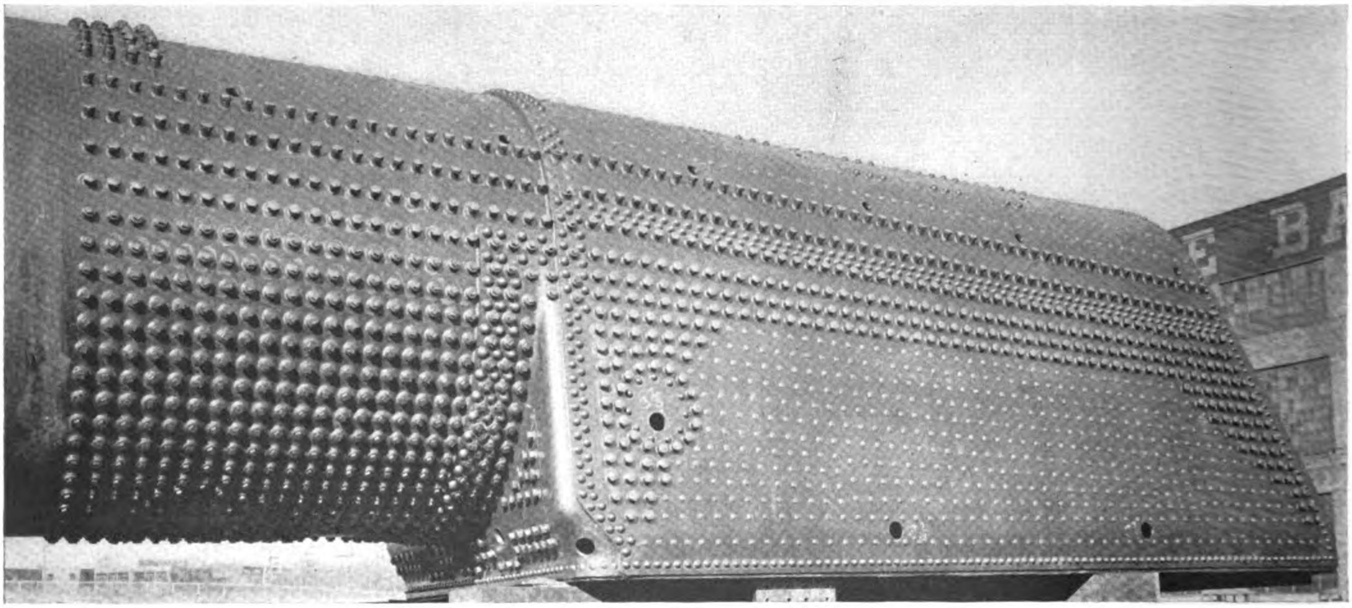
There are no grease cups on the rods. Grease lubrication is applied through the hollow-bored crank pins with pressure fittings in the ends.

The counterbalancing of these locomotives is such that at diametral speed the dynamic augment averages 5,135 lb. per wheel. In determining the weight of reciprocating parts the rotating portion of the main rod weight is calculated by the center-of-percussion method. The main driving wheels are cross-counterbalanced. Reciprocating parts on one side of the locomotive weigh 1,356 lb. on the front unit and 1,236 lb. on the back unit. An overbalance of 100 lb. is added to the counterbalance in each driving wheel, and the unbalanced reciprocating weight is thus 3.31 lb. per 1,000 lb. of locomotive weight.

Steam Distribution System

All cylinders operate on high-pressure steam directly from the boiler. Steam for the cylinders of both units is carried back from the branch pipes in steam pipes which lead to steam-chest connections at the front of each of the rear cylinders. From the back side of these connections pipes lead to a V-connection at the rear of the back cylinder saddle on the longitudinal center line of the locomotive. Steam for the front cylinders is carried forward through the rear cylinder saddle to a single pipe along the longitudinal center line of the front bed casting to a Y-connection behind the front cylinders from which branch pipes lead to the two front steam-chest connections. The two pipes to the rear cylinders terminate in expansion glands at the rear cylinders. A rear section of the single steam pipe to the front cylinders has an expansion joint and ball joints at the ends. The rear ball joint is housed in the front end of the rear cylinder saddle and the front joint in a pocket in the bed casting between the second and third pairs of driving wheels.

The exhaust pipes from the rear cylinder are carried forward along the lower quarter of the boiler to the smokebox. A single exhaust pipe leading from a Y-



The firebox and combustion-chamber staying

connection to the front ends of the forward steam chests is connected to the bottom of the smokebox. Both ends of this pipe have ball joints, and there is an expansion joint at the front end.

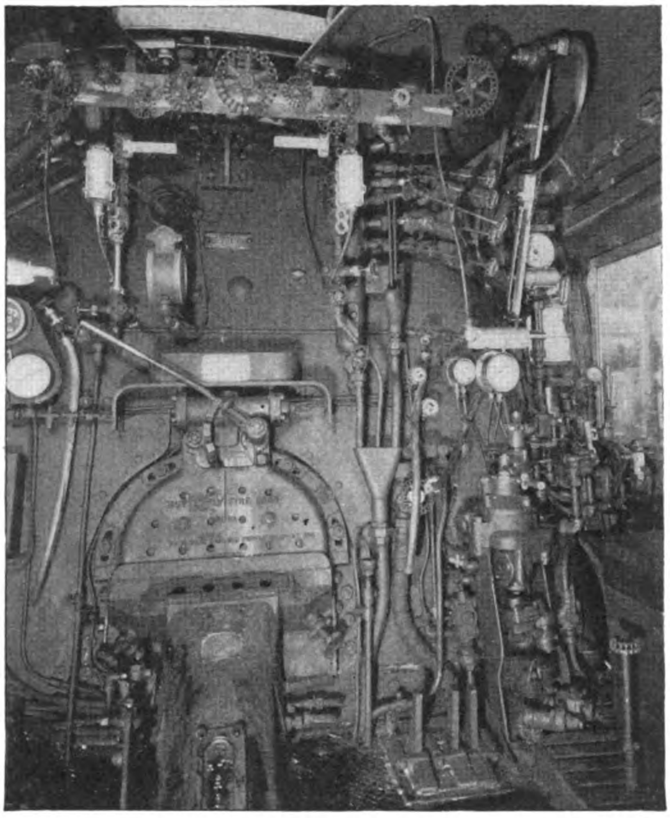
There are two stacks and two exhaust stands, one in front of the other. In order to get as long an exhaust-pipe connection from the front cylinders as possible, to keep the angular movement of the pipe on curves to a minimum, this pipe is carried back to the rear exhaust stand and the rear cylinders exhaust through the front exhaust stand. The exhaust nozzles are of the annular type. A Cyclone spark arrester is installed in the front end.

The locomotives have Walschaert valve motion controlled by an Alco Type H-12 power reverse gear. The reverse gear is supported from the bed casting.

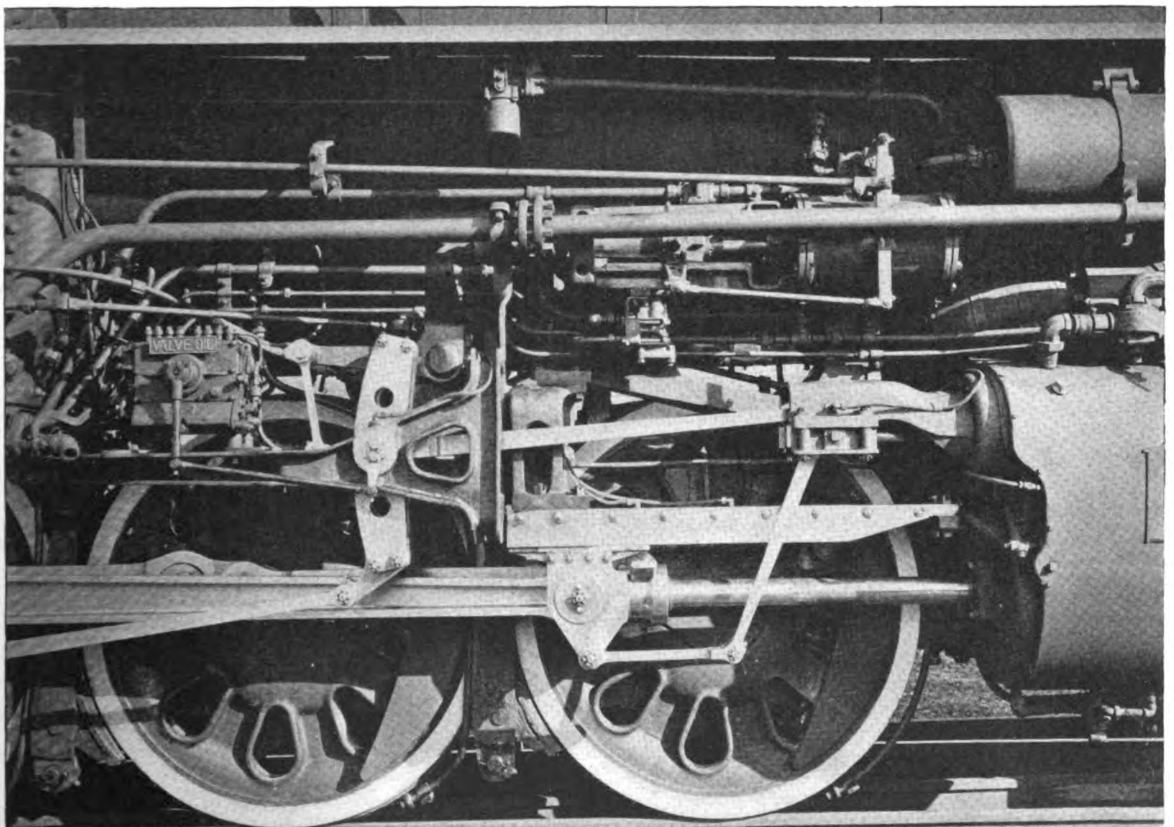
Lubrication

Force-feed oil lubrication has been employed extensively on the chassis of this locomotive. On the left side of each engine unit is a force-feed lubricator for engine oil. On the first six of these locomotives the lubricators are 32-pt. Detroit Model B, with 11 feeds on the front unit and 12 feeds on the rear unit. From these feeds, with one two-way and ten four-way dividers, this lubricator feeds oil to the reverse-link bearings, to the shoe and wedge faces of the six driving boxes, to the front truck pedestals, to the main guides, to the valve-stem guides, and to all driving-wheel hubs. The articulation hinge pins are also oiled from this lubricator. On the rear unit, with one two-way and eleven four-way dividers, similar bearings are lubricated and, in place of the articulation pins, oil is fed to the sliding waist bearer under the front end of the boiler.

Each of the second six locomotives is fitted with a 36-pt. Nathan DV-7 type lubricator on the left side of each unit, with 10 feeds on the front unit and 12 feeds on the rear unit. On these locomotives the hubs of the rear drivers on the front units are oiled from the lubricator on the rear unit.



The cab interior

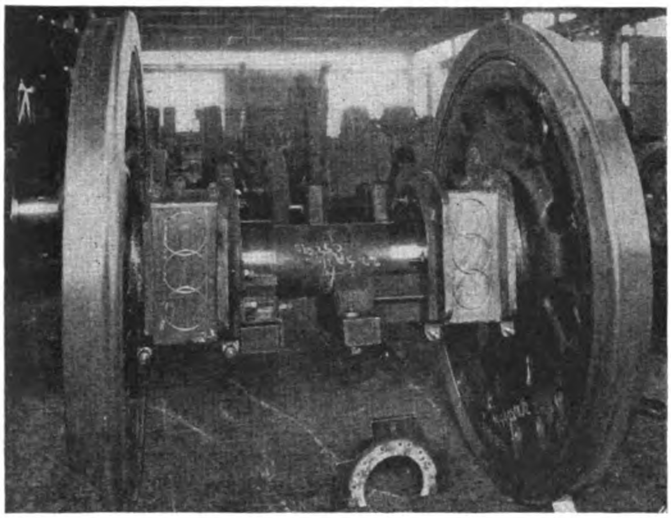


Running gear of the rear unit

On the right side of each engine unit is a mechanical lubricator for valve oil. From each of these lubricators two feeds lead to the cylinders and two to the valves. From the lubricators on both units oil is fed to exhaust-pipe and steam-pipe joints and the lubricator on the rear unit feeds also the stoker engine and the feedwater hot pump.

The valve-oil lubricators on the first six locomotives are 30-pt. Detroit Model A., with Detroit dividers and diaphragm terminal checks, while those on the second six locomotives are 36-pt. Nathan Type DV-7, with Nathan terminal checks. All of the locomotives are equipped with a Detroit 16-pt. mechanical lubricator which feeds flange-oiler shoes on the first pair of drivers on each engine unit.

Alemite grease lubrication is also used extensively on these locomotives. This application includes brake-rig-

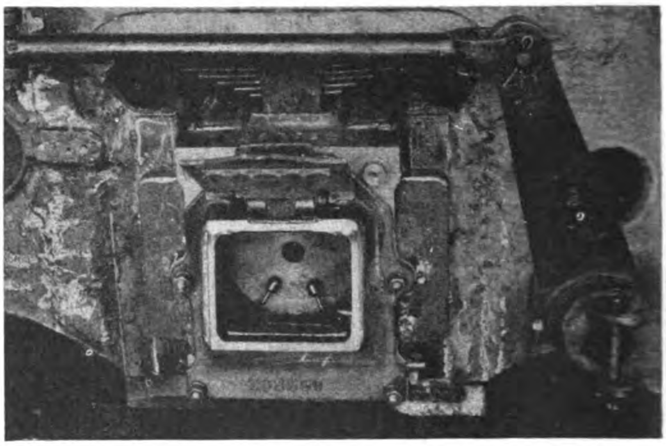


From the driving box at the right the Hennessy dust guard has been removed and the oil cellar partially withdrawn from the box

ging pins, crosshead and knuckle pins, drawbar pins, lubricator rigging, spring rigging, power reverse gear, stoker bearings, throttle rigging, the front-truck center

Partial List of Materials and Equipment on the Western Maryland 4-6-6-4 Type Locomotives

Engine bed; engine and trailer trucks	General Steel Castings Corp., Eddystone, Pa.
Engine truck wheels (front)	Bethlehem Steel Co., Bethlehem, Pa.
Driving wheels; trailer-truck wheels; axles; crank pins; connecting rods	Standard Steel Works Co., Burnham, Pa.
Tires, driving-wheel	Midvale Co., Nicetown, Philadelphia, Pa.
Springs	Crucible Steel Co. of America, New York
Automatic compensators and snubbers; radial buffer	Franklin Railway Supply Co., Inc., New York
Uncoupling device	Standard Railway Equipment Company, New York
Coupler; roller bearings (front engine truck)	American Steel Foundries, Chicago
Drawbar	Ewald Iron Co., Louisville, Ky.
Bearing metal—driving boxes, rods, etc.	Magnus Metal Div., National Lead Co., New York
Brake equipment	Westinghouse Air Brake Co., Wilmerding, Pa.
Driver and trailer-truck brakes	American Brake Company, St. Louis, Mo.
Cylinder protecting valves; cylinder cocks	The Prime Manufacturing Co., Milwaukee, Wis.
Piston heads and piston rods	Standard Steel Works Co., Burnham, Pa.
Piston-rod and valve-stem packing	U. S. Metallic Packing Co., Philadelphia, Pa.
Piston-packing and steam-chest valve-packing rings	Koppers Company, American Hammered Piston Ring Div., Baltimore, Md.
Cut-off and speed recorder	Valve Pilot Corporation, New York
Reverse gear	American Locomotive Co., New York
Crossheads	Standard Steel Works Co., Burnham, Pa.
Firebox steel	Bethlehem Steel Co., Bethlehem, Pa.
Boiler steel	Bethlehem Steel Co., Bethlehem, Pa. Carnegie-Illinois Steel Corp., Pittsburgh, Pa.
Boiler tubes	Pittsburgh Steel Co., Pittsburgh, Pa.
Boiler flues; steel pipe and mechanical tubing	National Tube Co., Pittsburgh, Pa.
Flexible staybolts and sleeves	American Locomotive Co., New York Flannery Bolt Co., Bridgeville, Pa.
Staybolt iron	(6) Ewald Iron Co., Louisville, Ky. (6) Ulster Iron Works, Dover, N. J.
Rivets	The Champion Rivet Co., Cleveland, Ohio
Engine-bolt steel; hexagon nuts	Milton Mfg. Co., Milton, Pa.
Slotted nuts	Russell, Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y.
Firebrick	American Arch Co., Inc., New York
Boiler and cylinder lagging	(6) The Philip Carey Co., Cincinnati, Ohio (6) Johns-Manville Sales Corp., New York
Superheater; Tangential steam dryer	The Superheater Company, New York
Thermic syphons	Locomotive Firebox Co., Chicago
Washout plugs; syphon plugs	Huron Mfg. Co., Detroit, Mich.
Smokebox hinges; feedwater strainer; blow-off cocks	Viloco Railway Equipment Co., Chicago
Blower valves; drain cocks; blow-off cocks	The Okadee Company, Chicago
Smokebox blower fittings	Barco Manufacturing Co., Chicago
Pipe unions (Corley)	American Radiator & Standard Sanitary Corp., New York
Pipe insulation:	
Main high-pressure superheater steam pipes	Johns-Manville Sales Corp., New York
All steam pipes not under jacket	Union Asbestos & Rubber Co., Chicago
Feedwater heater	Worthington Pump and Machinery Corp., Harrison, N. J.
Feedwater heater throttle	The Lunkenheimer Co., Cincinnati, Ohio
Injector	Locomotive Equipment Division of Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Boiler check for injectors and feedwater heater; coal sprinkler	Nathan Manufacturing Co., New York
Blower-pipe elbow	Barco Manufacturing Co., Chicago
Stoker	Standard Stoker Co., Inc., New York
Grates	Hulson Grate Co., Keokuk, Iowa
Spark arrester	Locomotive Firebox Co., Chicago
Cab apron; steel running boards	Alan Wood Steel Co., Conshohocken, Pa.
Cab side window sash	Aluminum Co. of America, Pittsburgh, Pa.
Clear vision windows; cab side windshields	The Prime Manufacturing Co., Milwaukee, Wis.



Hennessy lubricators are installed in the trailing-truck journal boxes—The pump-operating levers are shown against the end of the axle

Cab window glass	American Window Glass Co., Pittsburgh, Pa.
Throttle	American Throttle Co., New York
Safety valves	Ashton Valve Co., Boston, Mass.
Water gages	Hanlon Gauge Glass Co., Winchester, Mass.
Air and steam gages	Locomotive Equipment Division of Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Gage cocks; water column	Nathan Manufacturing Co., New York
Miscellaneous cocks and valves:	
For saturated steam	Ohio Injector Co., Wadsworth, Ohio
For superheated steam	Walworth Company, New York
Low-water alarm	Barco Manufacturing Co., Chicago
Whistle	Locomotive Equipment Division of Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Whistle operating valve	Viloco Railway Equipment Co., Chicago
Bell ringer	U. S. Metallic Packing Co., Philadelphia, Pa.
Rail washer	Nathan Manufacturing Co., New York
Sander valves and traps	T-Z Railway Equipment Co., Chicago
Lubricators, journal (drivers and trailer truck)	Hennessy Lubricator Co., New York
Mechanical lubricators (for cylinders, main valves, and chassis)	(6) Nathan Manufacturing Co., New York (6) Detroit Lubricator Co., Detroit, Mich.
Air-pump lubricator	Nathan Manufacturing Co., New York
Tire flange oiler	Detroit Lubricator Co., Detroit, Mich.
Oils and greases (initial lubrication)	Standard Oil Co. of New Jersey, New York
Grease fittings	Alemite Div. Stewart-Warner Corp., Chicago
Classification lamps	The Adams & Westlake Co., Elkhart, Ind.
Headlight; headlight generator; electric fittings; cab lamps	Pyle-National Co., Chicago

(Continued on page 55)

Field for High-Tensile

Steels in Freight Cars*

By A. F. Stuebing †

Five years of experience with freight cars built of high-tensile steels indicate how these materials should be used for maximum economy

In 1934, at a time when the railroads and car builders were eagerly searching for means of building more efficient freight equipment, the steel industry introduced low-cost steels having superior physical properties and greatly improved resistance to atmospheric corrosion. These materials, now usually designated as low-alloy high-tensile steels, were hailed as marking the advent of a new era that would be characterized by lightweight construction.

Five years have now elapsed since the first substantial numbers of freight cars built of high-tensile steels were placed in service. During that period the volume of production has increased and prices for the high-tensile steels, and for lightweight cars constructed of them, have been reduced considerably. It seems appropriate at this time to analyze the results obtained with the object of determining what influence these materials are likely to have on future development of railroad equipment.

Trends in Net Tons and Dead Weight

Before the low-alloy high-tensile steels were introduced, there had been a general trend toward freight cars of high capacity, primarily because the larger cars gave a more favorable ratio of pay load to dead weight and reduced costs due to the lesser number of units required. But in spite of the increase in car capacity, the tons per loaded car decreased. The best record in recent years was 27.1 tons in 1937, compared to 29.6 tons in 1920, although the average freight-car capacity increased from 42.4 tons in 1920 to 49.2 tons in 1937. The ratio of dead weight to load rose markedly from 104.40 per cent in 1920 to 138.94 per cent in 1937, and 149.67 per cent in 1938 as shown in Fig. 1. On some railroads, the ton-miles of dead weight in freight cars is now about three times the ton-miles of revenue and non-revenue load.

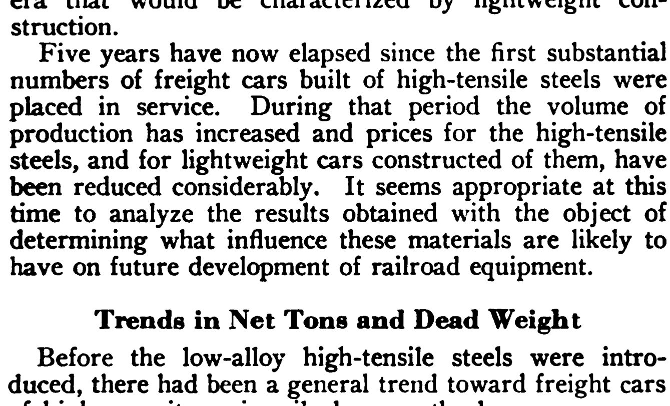


Fig. 1—Ratio of dead weight to load and percentage of loaded to total freight-car miles

It is interesting to observe how this trend has been reflected in the train load. The average freight train in 1920 carried 708 net tons of revenue and non-revenue load behind the tender; the cars, without lading, weighed 735 tons. In 1929, the average train load had increased to 804 net tons, or 13 per cent, but the weight of the cars had gone up to 1,061 tons or 44 per cent. In 1939, net tons per train attained a new high average of 813 tons. This was only 9 tons above 1929; but the weight of cars was 1,171 tons, or 110 tons more than in 1929. The variations in net tons and dead weight and the trends of each are shown in Fig. 2.

The installation of larger locomotives has enabled the railroads to haul substantially heavier freight trains, but the increase has occurred mostly in dead weight, not in revenue-paying tonnage. The average freight train in 1920 weighed 1,443 tons and earned $6.86 per mile. In 1939, the weight had increased to 1,984 tons but the revenue per mile had risen only 32 cents, to $7.18. This indicates that much of the gain in locomotive capacity has been offset by increases in the ratio of dead weight to pay load.

Cost of Hauling Dead Weight

In the early discussions of lightweight freight cars, the cost of hauling dead weight was recognized as a factor vitally affecting the profitability of freight service. The economies to be expected from weight reduction under various conditions were pointed out by such authorities as Ralph Budd, Joseph B. Eastman, K. F. Nystrom, and the Mechanical Advisory Committee to the Federal Co-ordinator of Transportation. These analyses generally accepted the principle that the savings in transportation expenses would be the proportion of each account affected which varied with the traffic, measured by the change in ton-miles, car-miles, or train-miles, according to which of these governed the individual account. Definite evaluations of savings were made on that basis and were in some cases applied by individual railroads.

Proceeding on the basis that savings in the cost of

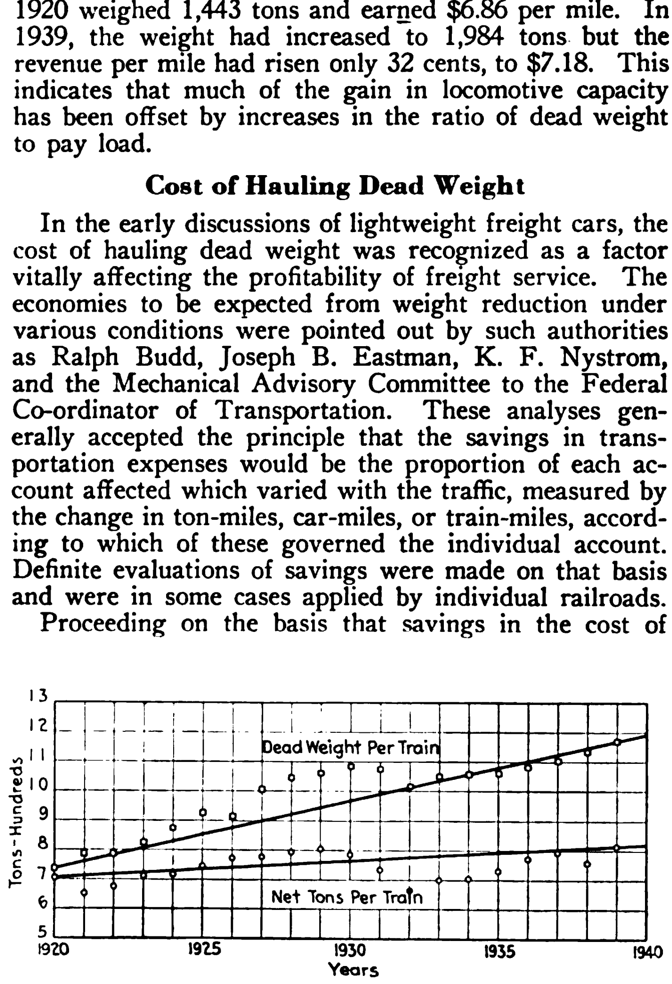


Fig. 2—Variations and trends in net tons and dead weight

* Paper presented before the November 21, 1940 meeting of the Railway Club of Pittsburgh.
† Development engineer, Carnegie-Illinois Steel Corporation.

transportation were of primary importance, the early high-tensile-steel cars were characterized by substantial weight reduction, compared with conventional cars. The cost of cars constructed of high-tensile steels was at that time generally $200 to $300 above the price for corresponding cars of copper steel. These additional expenditures were believed to be amply justified by the savings in operating costs that would result throughout the life of the equipment.

Experience with high-tensile steels in freight-car service has now been sufficiently extensive to enable any railroad to determine with reasonable accuracy how the use of various alternative applications of these materials will affect expenses and earning. At present, there is little uniformity of practice in the application of low-alloy high-tensile steels. Some cars are still being built with substantial weight reduction, but there is apparently a tendency toward compromise designs in which weight reduction is relatively small, the object presumably being to effect savings in car maintenance costs by the use of these superior materials.

The unit prices for high-tensile steels are now approximately one-fourth less than when these materials were introduced. The differential above the price of copper steel is about 50 per cent instead of 100 per cent. Under these circumstances, will it be more economical to use high-tensile steels with no change in thickness to reduce maintenance cost, rather than to decrease weight and improve the load ratio for the purpose of cutting transportation expenses? It will be worth while to analyze the factors involved in various alternative applications of corrosion-resisting high-tensile steels and to see to what extent the ultimate effect on the balance sheet can be determined at the present status of this development.

Effect of High-Tensile Steels on Costs

When any new type of material or construction is considered, one of the first questions raised is the effect on initial cost. In the case of freight cars, the total investment is large and fixed charges require careful consideration. The effect of the use of high-tensile steels on the initial cost of cars depends on the degree of weight reduction. Many applications of high-tensile steels do not increase the first cost. Box cars of these materials are available at prices no higher than conventional cars. High-tensile-steel hopper cars usually cost somewhat more per car, but frequently less per ton of capacity. One exception to these statements must be made in the case of cars with empty-and-load brakes, but less than one-sixth of all lightweight cars are so equipped.

By using low-alloy high-tensile steels, designers have an opportunity to reduce the cost of maintaining the bodies of freight cars, whether repairs result from mechanical damage or corrosion. Even when substantial reductions are made in the weight of the structure, cars of high-tensile steel, properly designed, have strength equal to or greater than cars of conventional heavy construction, and, in addition, these cars have superior resistance to corrosion.*

Fixed charges and maintenance costs are direct expenses and obviously are entirely chargeable to cars. The third important item, the cost of moving the car, is grouped with other expenses in the transportation accounts. Differences of opinion regarding the amount of transportation expense that can be saved by reducing the dead weight of freight cars are due to the complexity of the problem of determining to what extent these expenses will vary with a variation in car weight. However, logical methods of analysis have been developed by which the question of the amount that can be saved may be decided on the basis of facts instead of opinions.

The importance of considering operating savings in comparison with fixed charges and maintenance, is readily demonstrated. The average cost of freight cars at this time is about $2,700. Fixed charges on this sum at 8 per cent amount to $216 annually. Expenditures for repairs vary substantially from year to year. In 1938, they were $77.75 per freight car and, in 1937, $111.67.

Dividing expenses of conducting transportation, related solely to and apportioned to freight service by the average number of cars on line, we find that the cost of hauling each car and its contents was $520 in 1938 and $584 in 1937, exclusive of locomotive and track maintenance. Hauling costs in 1937 absorbed 5.7 times and, in 1938, 7.4 times the amount that was spent for car repairs and, based on the assumed price and rate, 2.4 to 2.7 times as much as fixed charges on new cars.

This comparison of expenses is over simplified. However, it brings out the fact that the largest opportunities for savings by the use of high-tensile steel in freight cars will almost certainly be found in operating costs rather than in maintenance. More thorough studies confirm this deduction and show that potential operating savings from lightweight high-tensile-steel cars are ample to absorb fixed charges on the slight additional cost and leave a substantial profit. Some economies may be effected by applying high-tensile steels to increase the period between repairs or replacements, but under normal operating conditions the largest gains are to be expected by using these materials in equipment which takes full advantage of the possibilities of weight reduction without sacrificing strength.

High-tensile-steel freight cars afford opportunities for operating and maintenance savings without any substantial increase in capital investment. Hence, they are now not an item of extra expense but a means of effecting extra savings. What the railroads need in freight-car material is strength and serviceability. At present prices, corrosion-resisting high-tensile steels cost less per unit of strength and per unit of life than copper steel which was previously the most economical material for such applications. The idea that weight and thickness are criterions of strength and serviceability will be abandoned by anyone who carefully compares the performance of high-tensile-steel cars with that of conventional equipment. Mere bulk is not essential to produce the strength required in cars unless the design is so crude as to be obsolete according to present-day standards.

The facts now available enable any railroad to determine with reasonable accuracy the relative costs for conventional freight cars and for high-tensile steel equipment. If such studies are made when new cars are being considered, applications that are of doubtful value can readily be avoided. However, on the basis of analyses that have already been made, it appears that lightweight high-tensile steel construction will be found more economical than conventional designs for a majority of all freight cars.

Discussion

C. O. Dambach, superintendent, Pittsburgh and West Virginia, referred to the statement that hopper cars of high-tensile steel usually cost more per car but frequently less per ton of capacity. What effect, he asked, does the method of loading have on the calculations? In reply, Mr. Stuebing said that his statement was based on the present method of rating car capacity, namely, the maximum permissible weight on the rail minus the light weight of the car. The reduction in the weight of the

* See report of Comparative Impact Tests of Pullman lightweight box car of 1937 and A. A. R. standard box car of 1932, and also article entitled Service Life of Cor-Ten Steel in Hopper Cars, page 847, December 2, 1939, Railway Age.

car results in a corresponding increase in the load that the car can carry. Therefore, if the increase in the cost of the car is less than the increase in the weight that can be carried, both on a percentage basis, the cost per ton of capacity of the car built of high-tensile steel would be less than the cost of a conventional car.

Karl Berg, superintendent motive power, Pittsburgh and Lake Erie, inquired if high-tensile steel is intended specifically for application to the car body or to the trucks and other parts as well. Mr. Stuebing replied that low-alloy high-tensile steels are primarily structural steels for use in the car body and are not intended to be forging steels.

Prof. Louis E. Endsley, consulting engineer, Pittsburgh, Pa., called attention to a paper on lightweight railroad equipment which he had presented earlier in the year. In this paper he had quoted figures to show that a reduction of 10,000 lb. in the weight of a freight car could be made by the use of this new steel. He had also quoted figures to show the cost of hauling dead weight in a freight car. Even the lowest of these figures, $12.00 per ton per year, would show an operating savings of $60.00 per car per year, if the light weight could be reduced five tons.

F. I. Snyder, vice-president and general manager, Bessemer & Lake Erie, reviewed the experience on his road with cars of lightweight construction. In the last five years, he said, nearly 70 per cent of the freight cars on the Bessemer have been built new and of these 6,200 are lightweight, open-top cars constructed of USS Cor-Ten steel. The 90-ton hopper cars of high-tensile steel show a savings of 10,000 lb. in the light weight as compared with the standard design for a hopper car of conventional steel built in 1931. This means that an additional five tons of revenue load can be hauled per car without an increase in gross load or cost. The same is true of the 70-ton cars which are built of low-alloy, high-tensile steel. In handling coal, the gain in revenue load for the cars of larger capacity without any increase in the rail load is 7,000 lb. The saving is less than for ore because cubical capacity and not axle capacity governs the loading of coal.

"We have not had much experience in the maintenance of these lightweight cars," Mr. Snyder continued, "because the average length of service of these cars over this five-year period is obviously two to three years, as the cars were purchased in six different lots. The tests which have been made of USS Cor-Ten steel have been very extensive and show qualities of durability which point to a decrease in maintenance costs. However, in our experience, the saving in transportation costs is so large that maintenance costs become of secondary importance. The value of the new cars will be enhanced by the economy anticipatd in maintenance. The effect of the new cars on car mileage is shown by a comparison of car operation in 1939 compared with the five years previous to the USS Cor-Ten open-type cars. There was a saving of 15 per cent in the car mileage, part of which is due to the increased nominal capacity of the new car but a large percentage is also due to the light weight of the car. There was an article in the Railway Age about two months ago on the operation of lightweight cars of large capacity and any one interested will find a lot of information in this article."

A. Stucki, president, A. Stucki Company, Pittsburgh, Pa., asked if this high-tensile steel had been used in the construction of boilers. In answer, Mr. Stuebing said that the low-alloy high-tensile steels had not been applied to boilers as they do not seem to be particularly adapted to that purpose. Up to this time it has not appeared that the requirements for boiler steel would be met better by the low-alloy high-tensile steel.

Western Maryland 4-6-6-4 Type Locomotives

(Continued from page 52)

Car replacers	American Chain & Cable Co., Inc., Bridgeport, Conn.
Metallic connections between engine and tender; joints in locomotive piping between articulated units	Barco Manufacturing Co., Chicago
Paint	E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.
Tender:	
Frame; trucks	General Steel Castings Corp., Eddystone, Pa.
Springs	Crucible Steel Co. of America, New York
Wheels	Standard Steel Works Co., Burnham, Pa.
Axles	Bethlehem Steel Co., Bethlehem, Pa.
Journal boxes	Symington Gould Corp., Rochester, N. Y.
Journal lubricators	Hennessy Lubricator Co., New York
Truck side bearings	A. Stucki Co., Pittsburgh, Pa.
Coupler	American Steel Foundries, Chicago
Coupler centering device and uncoupling arrangement	Standard Railway Equipment Company, New York
Draft gear	W. H. Miner, Inc., Chicago
Clasp brake	American Steel Foundries, Chicago
Brake shoes	American Brake Shoe & Foundry Co., New York
Tank plates	Bethlehem Steel Co., Bethlehem, Pa. Carnegie-Illinois Steel Corp., Pittsburgh, Pa. Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Washout plugs	Huron Mfg. Co., Detroit, Mich.
Hose strainer	The Okadee Co., Chicago
Water-level indicator	Locomotive Equipment Division of Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Marker lamps	Pyle-National Co., Chicago

plate, valve-motion pins, trailer-truck center plate, and the radial buffer. The furnace bearers are lubricated from oil cups.

The Cab and Tender

The cabs are steel, riveted, and are lined throughout with wood. They are of the vestibule type and are entered by swinging side doors, also of steel. The sash are of extruded aluminum and all glass is shatterproof.

One of the features of the cab arrangement provided for the comfort of the crew is a ½-in. breather pipe which extends across the back head of the boiler and which is connected to the main-reservoir air line. This pipe feeds several lateral lines closed with ¼-in. globe valves, each of which ends with 3 ft. of ½-in. hose. This arrangement permits members of the crew to have an individual supply of fresh air when passing through tunnels.

The cab is particularly roomy and is conveniently arranged. Extension handles from the auxiliary valves are readily accessible and are labeled.

The superheated-steam turret is mounted outside the smokebox in front of the superheater header. From it steam is fed to the air pumps, the stoker, the blower, and the whistle. A manifold for air auxiliaries is in the cab.

The air-brake equipment is Westinghouse No. 8ET. There are two 8½-in. cross-compound air compressors which are mounted on the deck of the front engine unit. Brakes are applied on all engine and tender-truck wheels, except those of the front engine truck. The locomotives have Brewster sanders, delivering in front of all drivers and in back of the main drivers. A Nathan rail washer is manually controlled by the engineman, both in forward and backward motion.

The tender tanks are copper-bearing steel of riveted construction, built up on General Steel Castings water-bottom frames. The six-wheel trucks are of General Steel Castings swing-motion type and have standard bronze bearings. Hennessy journal lubricators are applied in the journal boxes. The trucks include Unit cylinder clasp brakes.

The engine and tender connections consist of the Unit safety drawbar and the Franklin Type E-2 radial buffer. Barco type 3-VX pipe connections are used between the engine and tender. Barco connections are also used between the engine units. The tender draft gear is Miner A22XB.

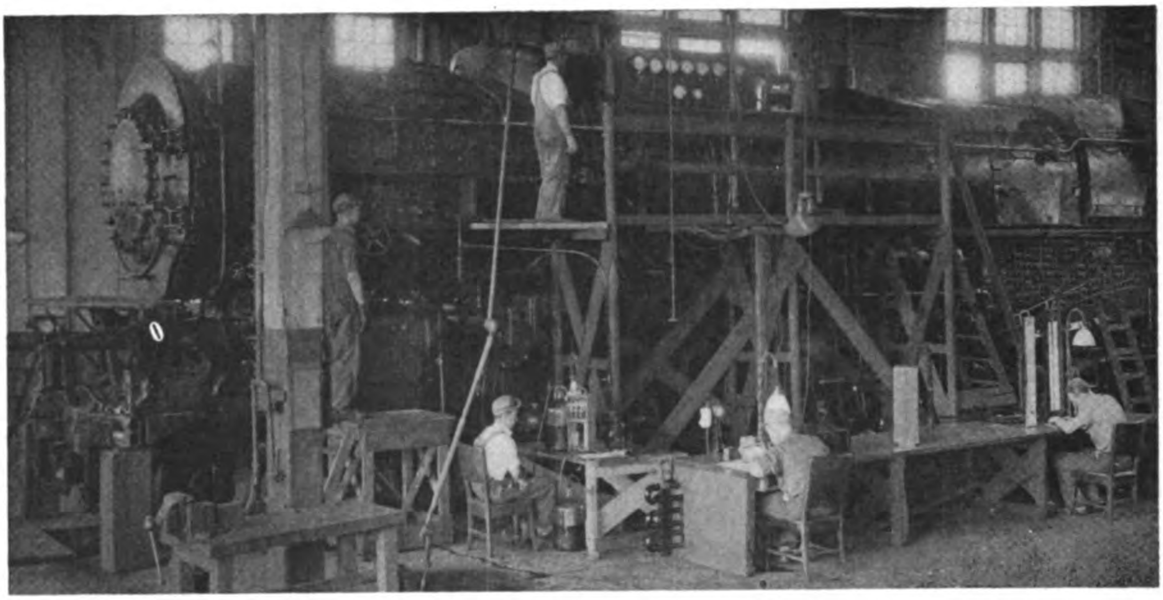


Fig. 1—Arrangement of equipment for standing tests at the Selkirk, N. Y., enginehouse of the New York Central

New York Central's

Standing Locomotive Tests*

Part I

By W. F. Collins †

Test method developed to control temperature and pressure of exhaust steam in study of front-end design—Effect of various changes in the front end on the boiler performance

TESTS made by road or stationary dynamometer have been the means of studying the effect of changes made in the design of smokebox arrangements. These tests are costly and other means have been tried in their place; namely, the model tests and locomotive standing tests.

The locomotive standing tests offer one method for this study where uniformity of conditions can be maintained, the effect of minor changes can be observed, and the road performance predicted without incurring either the difficulties of procedure or the uncertainties in the results of road tests. This method of test offers simple and effective means for improving the design of smokebox arrangements and nozzles. It should be added that the standing tests are suitable not only for the study of smokebox problems but for other tests in which the performance of the boiler only is involved; such as the performance of feedwater heaters, fuel, stokers, etc.

Early Locomotive Standing Tests

Early locomotive standing tests were made by the New York Central at Gardenville, N. Y., enginehouse in 1923 by placing the locomotive in a fixed position, disconnecting the engine machinery and operating the boiler. The piston was removed and the gland opening was closed by suitable means, so that the cylinder served as an expansion chamber. The exhaust pressure was maintained constant by the regulation of a special gate valve installed above the steam chest. The exhaust pressure for any given smokebox arrangement determined the quantity of air moved. This air, in turn, determined the rate of combustion and the amount of steam generated. The steam generated by the boiler was passed, either wholly or in part, through the exhaust nozzle in the usual way.

It was recognized‡ that while these tests served admirably as a means for studying the effect of smokebox changes, the value of different nozzles, etc., they could not be used as a reliable indicator of actual nozzle area until considerable experience and judgment had been acquired. The reason for this statement is that the exhaust steam had a greater volume for a given exhaust pressure, owing to the high degree of superheat, which ranged from 300 to 450 deg. F. While the boiler pressure was reduced to a predetermined value equal to that of the exhaust pressure there was no reduction in temperature corresponding to the thermal heat drop in the cylinders when mechanical work is performed and transmitted to the drivers. The total enthalpy of the steam at boiler pressure was approximately the same for the exhaust steam and, therefore, the specific volume during

* Paper presented at the annual meeting of The Railway Fuel and Traveling Engineers' Association on October 23, 1940, at Chicago. This paper will be published in two parts.
† Engineer of tests, New York Central.

‡ See "Standing Tests of Locomotives Offer Practical and Simple Means for Studying Draft Appliances," 1930 Proceedings, International Railway Fuel Association.

the test was 50 per cent greater than that obtained during road operation. Consequently, the exhaust steam of the early standing tests had a higher velocity through the stack which resulted in moving a greater quantity of air than could be accomplished in road service with the same size nozzle. Conversely, a nozzle with a greater area, resulting in lower exhaust pressure, could be used during standing tests to move the same quantity of air as required for road service.

As the amount of gas expelled from the smokebox by the exhaust nozzle and stack combination depends on the energy in the steam rather than the weight, the results in some cases have been misleading and none were comparable with those obtained on road tests. A mention of this condition is made at length in order that results of the early standing tests may be properly appraised, and the conclusions developed from these results considered accordingly.

Recent Locomotive Standing Tests

In view of the information given above, some time was spent by the author in studying the results obtained by these early standing tests. The conclusion reached was that a control of the temperature was also needed in the modern locomotive using superheated steam if the test results obtained on these standing tests were to approximate those obtained in road service. In other words, it was not only necessary to reduce the pressure, but also the temperature and the enthalpy so that thermal conditions, or the state of the exhaust steam during the standing tests, would be identical to the thermal conditions experienced in road tests.

The method for controlling the temperature of the exhaust steam during the standing test is through the medium of the spray of water mist in the cylinder which is subsequently removed in its entirety. The locomotive standing test with the exhaust temperature thus controlled produces a more accurate and economical method

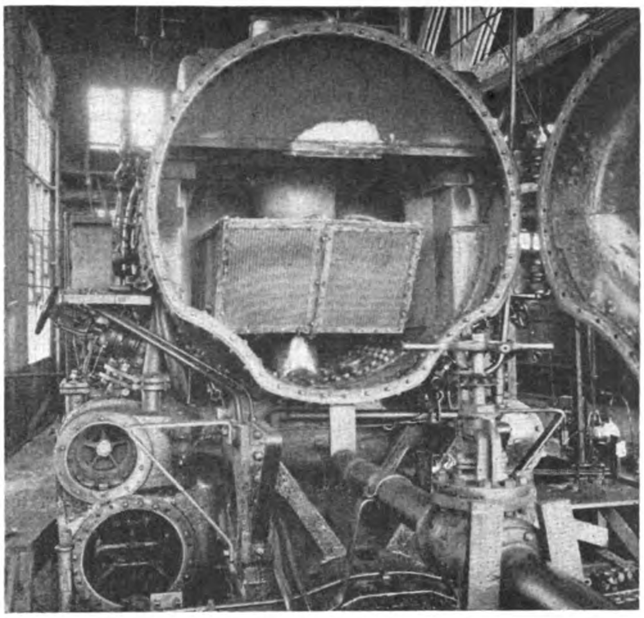


Fig. 3—The water sprays may be seen in the cylinder—The bleed-off control valve is in the foreground

for study than heretofore. The performance of the locomotive boiler is considered to be entirely independent of the engines and subject to its own particular laws. It is the boiler rather than the engines which determines and limits the capacity of the locomotive.

Fig. 1 shows the general arrangement of a New York Central locomotive on a recent standing test at the Selkirk, N. Y., enginehouse. The method of testing a stationary locomotive boiler by special means and for controlling temperature and pressure of exhaust steam to the nozzle is shown in Fig. 2.

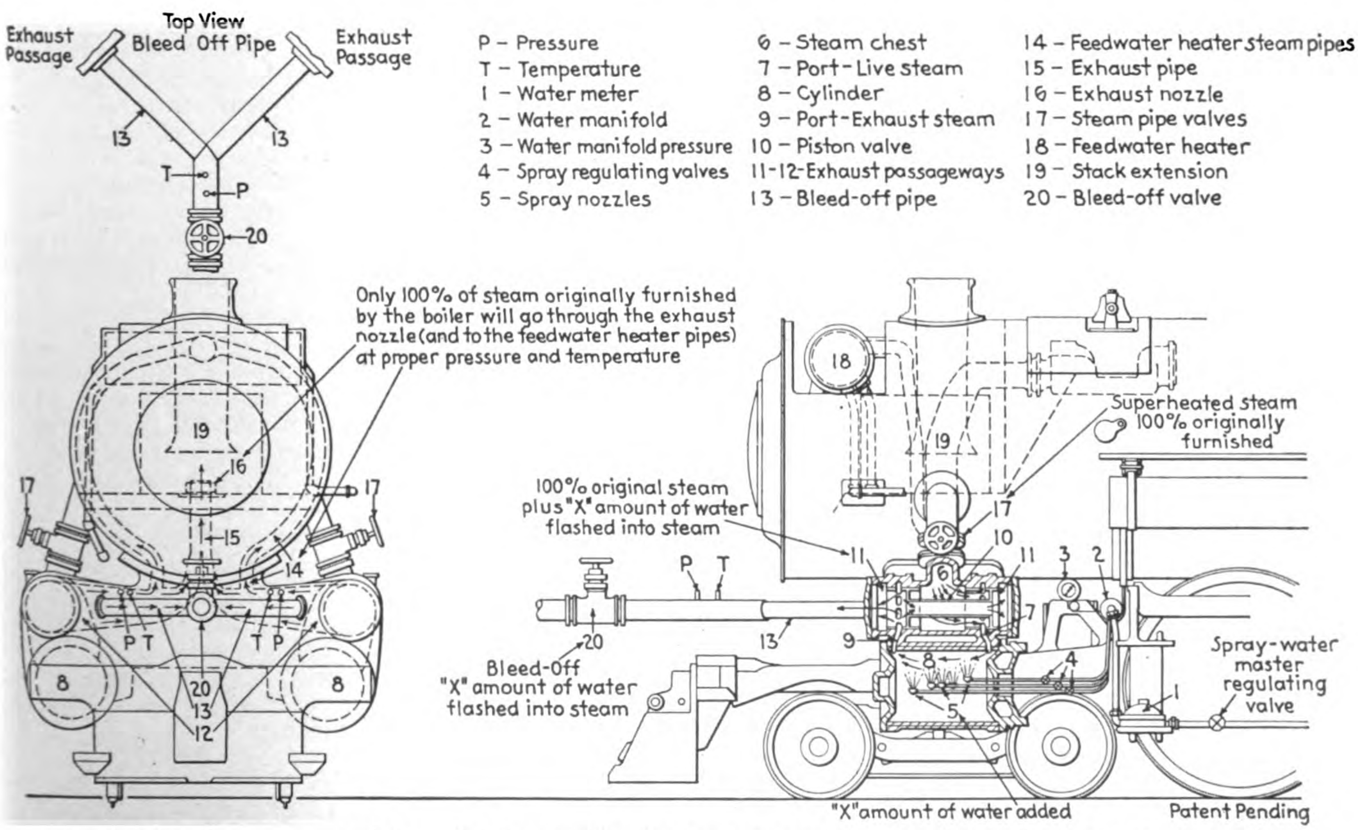


Fig. 2—Schematic arrangement of the method for controlling the temperature and pressure of the exhaust steam to the nozzle

The superheated steam, which may be designated as 100 per cent at the steam-pipe valve *17* is admitted to the valve chest *6* and from there passes through the valve bushing at the rear of the valve chest and into the cylinder where it encounters a series of sprays of water and is reduced in temperature or desuperheated. The controlled sprays add an X amount of water and the 100 per cent of steam plus this X amount, which has been flashed into steam from the water, passes from the cylinder through the valve bushing at the front end of the valve chest and into the exhaust passageways. From the exhaust passageways the steam divides, part passing through the nozzle *16* and part passing through the bleed-off valve *20* where an X amount of steam is extracted or bled off in order that only 100 per cent of the steam originally furnished by the boiler will go through the exhaust nozzle (and to feedwater-heater steam pipes *14*) at the proper pressure and temperature. Fig 3 shows the sprays *5* in the cylinders, the bleed-off valve *20*, and the steam-pipe pressure valve *17*.

Fig. 4 shows graphically the results from a road dynamometer test and a recent standing test for the same New York Central Class J-1 locomotive with identical arrangements of the smokebox, firebox and nozzle. It

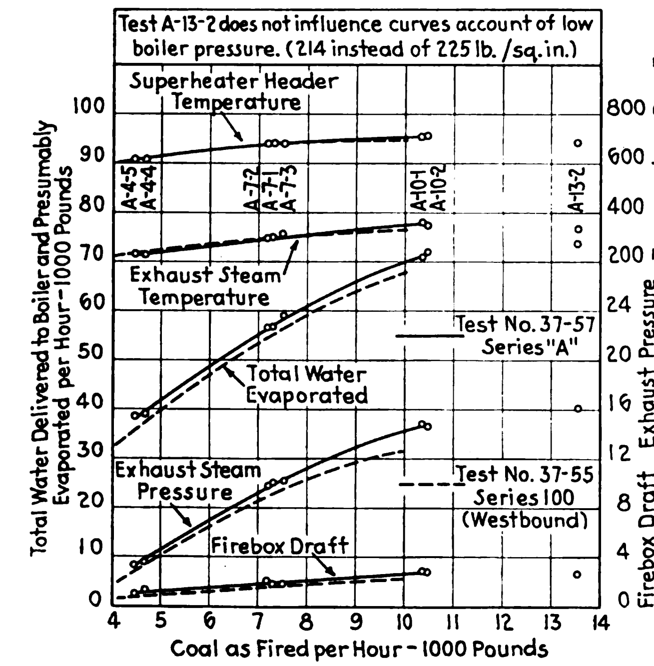


Fig. 4—Comparison of results from a road dynamometer test and a standing test for the N. Y. C. Class J-1b locomotive No. 5224 with identical arrangements of firebox, smokebox and nozzle

was noted that the apparatus and method of a standing test duplicate exactly the thermal conditions that take place when steam is used during road tests, or during stationary dynamometer tests where the main pistons are used to convert the energy of the steam into work at the drivers.

Properties of the Exhaust Steam

The properties of the exhaust steam in road service show that the degree of superheat changes with the quantity of steam flowing through the nozzle and is related to the cut-off of the engines. The degree of superheat ranges from about 20 deg. F. at the steam rate of 30,000 lb. per hr. to about 90 deg. F. at a steam rate of about 80,000 lb. per hr. The exhaust pressures and temperatures used on the standing tests are obtained from the same class of locomotive selected for this purpose in road service under maximum operating conditions.

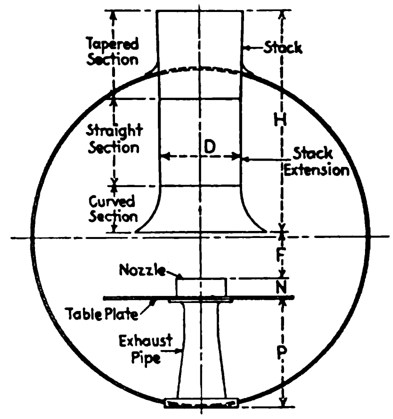


Fig. 5—Designation of lettered dimensions in the front end

The exhaust nozzle and stack present many problems for research and with better knowledge of them it may prove possible to furnish the air for combustion at appreciably less exhaust pressure.

Results from Recent Standing Tests

A mention of the recent locomotive standing test results obtained in connection with the New York Central's investigation of the smokebox arrangement was made before this association by M. S. Riegel, assistant engineer of tests, New York Central, at the November, 1938, meeting.

The results to be presented here were obtained from tests conducted on the plant described above and, in each case, identical test conditions prevailed for each series of tests so that the results would be comparable. These results concern particularly the tests of a smokebox arrangement for a modern coal-burning steam locomotive whose pertinent boiler characteristics* will be given in the graphs showing the rate of evaporation.

The tests of the J-1 locomotive covering the *ZM* series (improved smokebox arrangement) and the *A* series (standard smokebox arrangement) were conducted with the same size of exhaust nozzle (7⅜ in. diameter) and the same size and type of basket bridge. The results obtained for the two series are directly comparable. The results of the *ZM* series and those of the *B* series (standard smokebox arrangement 6¾-in. nozzle) are not directly comparable because of the difference in exhaust-nozzle diameter. However, a comparison is made herein since the Class J-1 locomotives in road service have been equipped with the standard smokebox arrangement and 6¾-in. nozzle.

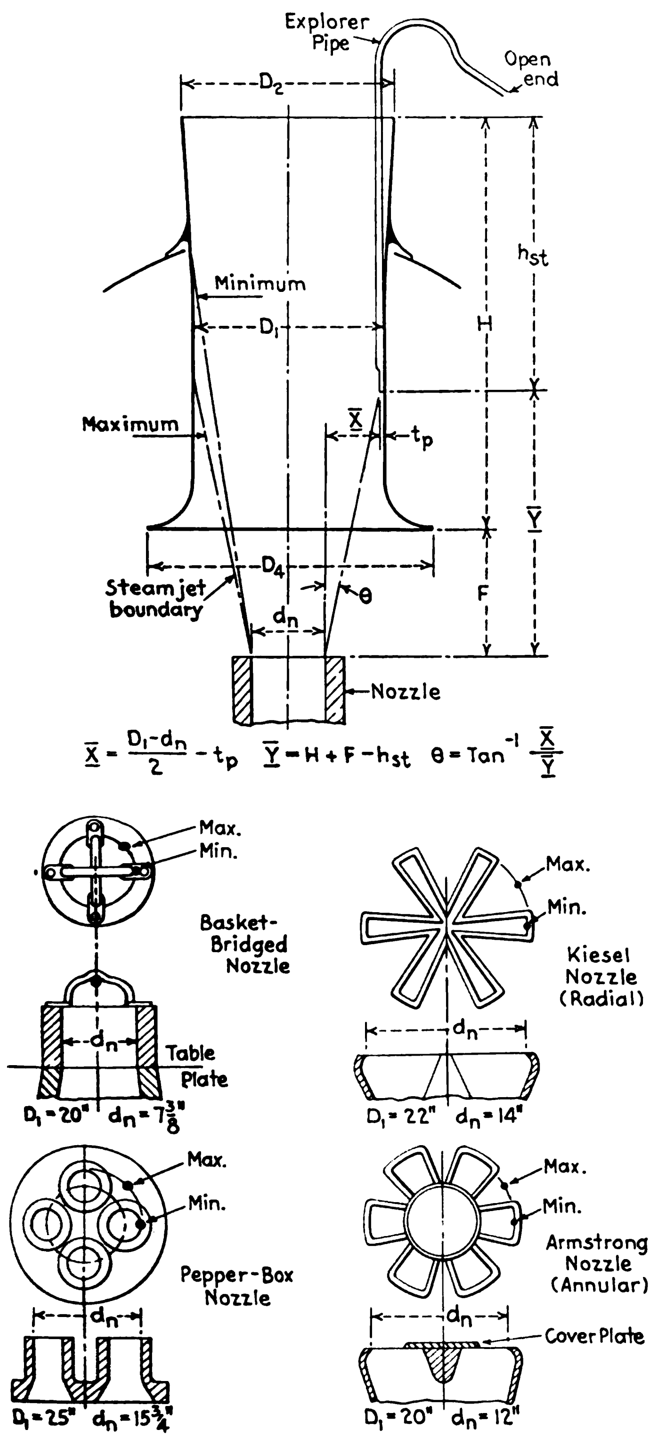
Some of the preliminary results of the Class J-3 locomotives will also be shown—The *JB* and *JR* test series covering nozzle tests, and a comparison of the evaporation rates of the *JR* series (improved smokebox arrangement) equipped with 7-in. divergent nozzle and the *AA* series (standard smokebox arrangement) equipped with 6¾-in. nozzle. All of these series use the ½-in. basket bridge.

Stack and Stack Extension

The effect of changing the diameter of the stack was investigated (see *D* in Fig. 5) and it was found that by increasing the diameter the performance and capacity of the boiler was increased. The limit of the stack diameter being governed by the velocity of the discharge of the gases and steam from the outlet of the stack which is related directly to smoke trailing.

* Additional boiler data enumerated in C. A. Brandt's paper, "The Locomotive Boiler" presented before the Railroad Division, American Society of Mechanical Engineers, on December 4, 1939, at Philadelphia, Pa. An abstract of this paper appeared in the February and March, 1940, issues of the *Railway Mechanical Engineer*.

The contour of the stack extension was studied and it was determined that a liberal radius is desirable but increases in the length of the radius had no appreciable effect upon the performance of the boiler. It was found that the straight portion of the stack extension had a definite relation to the type and kind of nozzle used. In general, it was found that a straight length of the stack of about 1½ diameters gave the best performance of the boiler and if less than this ratio was used the performance



Nozzle	Coefficient of discharge at 65,000 lb. of steam per hr. through nozzle	Angle of jet contact with stack, deg. Max.	Min.
Basket bridge	0.91	16	7½
Pepper-Box	0.93	6	4
Kiesel (radial)	0.90	6	3½
Armstrong (annular)	0.91	8	4½

Fig. 6—Method of determining the angle of jet contact with the stack—The jet angle and coefficient of discharge for various nozzles

was found to be slightly impaired in each instance. The length of the straight section of the stack governs the total or over-all length of the stack and stack extension.

The effect of changing the diverging taper of the stack was investigated to a limited extent. It was found that the usual two-inch taper per foot of length of stack was satisfactory, although a taper of only one inch per foot of length was used without any appreciable detrimental effect upon the performance of the boiler. The performance of a stack with straight sides did not equal the performance of the tapered stack, except when special nozzles were used. With special nozzles, the straight stack did not exceed the performance of the boiler with tapered stack and circular nozzle with basket bridge for stacks of equal choke diameters.

The effect of changing the distance from the table plate to the lower edge of the stack extension (*N* plus *F* in Fig. 5) by varying the length of the stack was studied in connection with the basket bridge nozzle and it was found that below 8 in. and above 24 in. the boiler performance was adversely affected. Between these limits the performance of the boiler was not appreciably affected but the best performance was obtained with a dimension of 16 in. The reason for the poor performance below 8 in. was due to the restriction of the stack to the gases, as reflected by the gas analysis. Above 24 in., the operation of the arrangement was unstable at the high rates of evaporation due to the impingement of the steam jet against the radius of the stack extension.

A study was made of the effect of changing the distance from the exit end of the exhaust nozzle to the lower edge of the stack extension (*F* shown in Fig. 5) by varying the length of the nozzle while the distance between the table plate and the stack remained constant. This latter measurement was 16 in.

For an *F* dimension ranging from 12 to 2 in., the performance of the boiler was not appreciably affected and the best performance was found to be at 10 in. At less than 2 in. below the edge of the stack and 6 in. above the edge of the stack, where the nozzle penetrated into the stack, the boiler performance was unstable and the higher rates of evaporation could not be obtained. The steam impingement of the jet upon the stack could not be obtained with the exploring tube and evidently the jet did not contact the upper portion of the stack.

Impingement of Steam Jet upon the Stack

The impingement of the steam jet upon the stack was investigated for stacks with diameters of 18, 19, 20, 22, 25 and 26 in. The angle of the steam jet leaving the nozzle was calculated from this data.

In general, no nozzle tested gave a single jet angle, as the jet angle changed from a minimum to a maximum for each type of nozzle tested. Fig. 6 shows the equipment and method of determining the angle of jet contact with the stack, together with information showing the jet angle obtained and the coefficient of discharge for the different nozzles shown. The jet angle varies slightly with the rate of steam discharged through the nozzle at different exhaust pressures. In the design of a smokebox arrangement, it is evident that the particular nozzle under consideration or test should be given special consideration in relation to the stack selected.

The basket bridge used with the circular nozzle was made from a rod ½ in. in diameter. When a ¾-in. diameter bridge was used a greater angle was obtained and a lower impingement was noted on the stack. A special ½-in. bridge was developed which resulted in a smaller angle and a higher impingement on the stack.

(*To be concluded*)

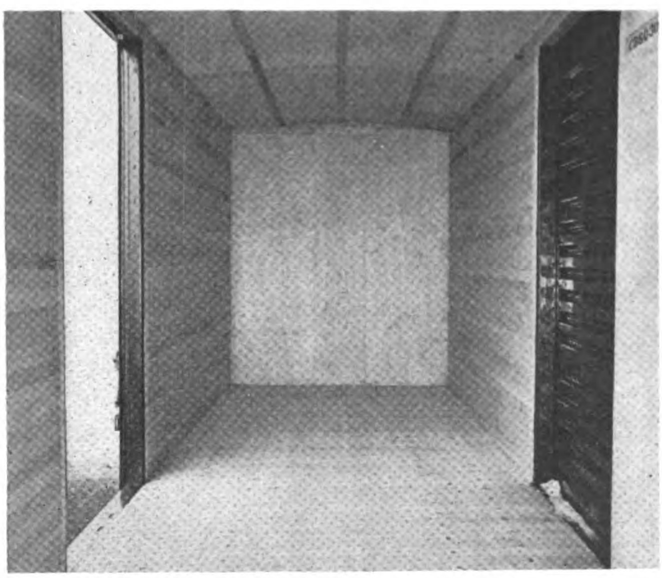
New box cars on the delivery track outside Havelock shops

C. B. & Q. Builds

A Thousand Box Cars

Fifty-ton steel-sheathed cars, built at Havelock, Neb., follow A. A. R. design — Fifty are equipped for head-end passenger-train service

With heavy motive-power repairs largely concentrated at shops in West Burlington, Ia., and Denver, Colo., the Chicago, Burlington & Quincy removed much of the machinery from its Havelock, Neb., locomotive shop a few years ago and made such revisions of shop equipment as were necessary to adapt this shop to freight-car rebuilding and new construction programs. With excellent heat, light and crane facilities, the limitation of a relatively short shop (about 600 ft.) has been overcome by moving cars from one position to the next down one track in the erecting shop and back another, so that 24 cars in various stages of construction can be accommodated in the main shop building. Necessary sand-blasting and cement-spraying operations are performed outside and painting in a well-equipped paint shop built in part of the old boiler-shop building. With detail construction and assembly operations organized on a production basis, this shop is well adapted to show excellent results in turning out either new or rebuilt cars.



The ceiling and end lining are Douglas fir plywood

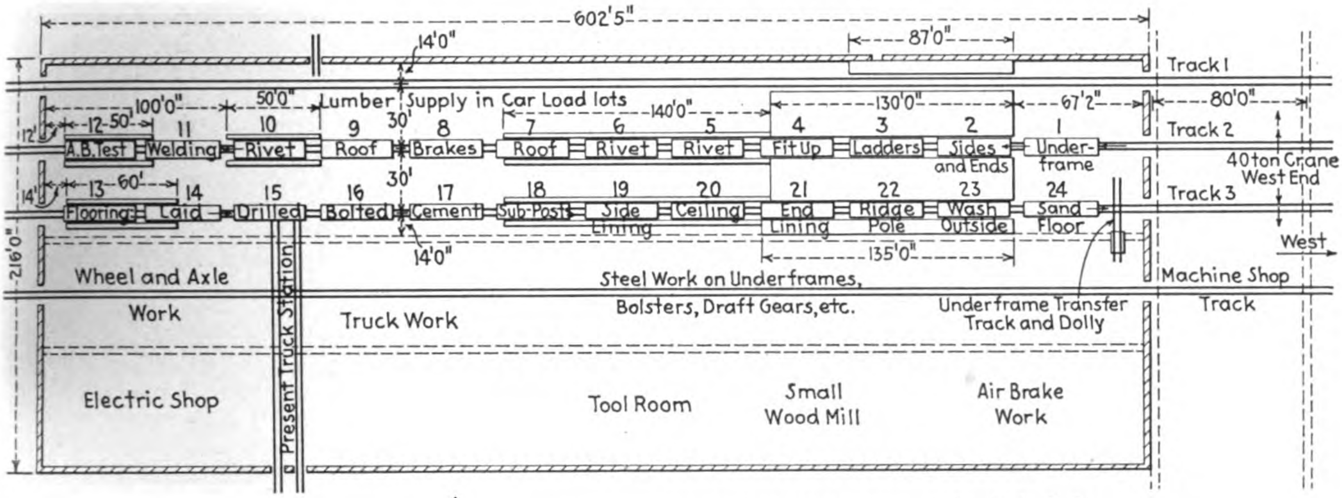
At the present time, for example, a series of 1,000 modern 50-ton steel-sheathed box cars is being constructed at Havelock shops and, with the production line timed for a move every 38 minutes, the output is 12 cars one day and 13 cars the next, with a total force of 219 men, including 110 mechanics, 87 helpers, 8 laborers, 14 welders and painters. Some idea of the workmanship built into these cars is given by the leading illustration, which shows a group of cars just out of shop. The cars are stencilled Burlington Route, Way of the Zephyrs on one side and Everywhere West on the other. Recognizing the probability of unexpected delays at various points in the car assembly line, a limited number of materials and parts have been provided at strategic points in advance so that they can be injected into the production line and enable the daily output mentioned to be maintained with notable regularity.

General Dimensions of New Burlington 50-Ton Box Cars

Inside length, ft.-in.	40- 6
Length over end sills, ft.-in.	40- 8¼
Length over striking plates, ft.-in.	41- 8½
Width inside, ft.-in.	9- 2¹/₁₆
Width over side sills, ft.-in.	9- 9⅝
Width of door opening, ft.-in.	6- 0
Width over all, not to exceed, ft.-in.	10- 8
Inside height, floor to ceiling eaves, ft.-in.	10- 6
Height, rail to floor top, ft.-in.	3- 7¾
Height, rail to top of running board, ft.-in.	15- ⅜
Height, rail to center of coupler, ft.-in.	2-10½
Height, rail to body center plate, ft.-in.	2- 1¾
Height, door opening in the clear, about, ft.-in.	9-11½
Truck centers, ft.-in.	30- 8½
Truck wheel base, ft.-in.	5- 6

Principal Features of the Cars

The 1,000 new Burlington 50-ton box cars, built essentially of open-hearth copper-bearing steel by a combina-



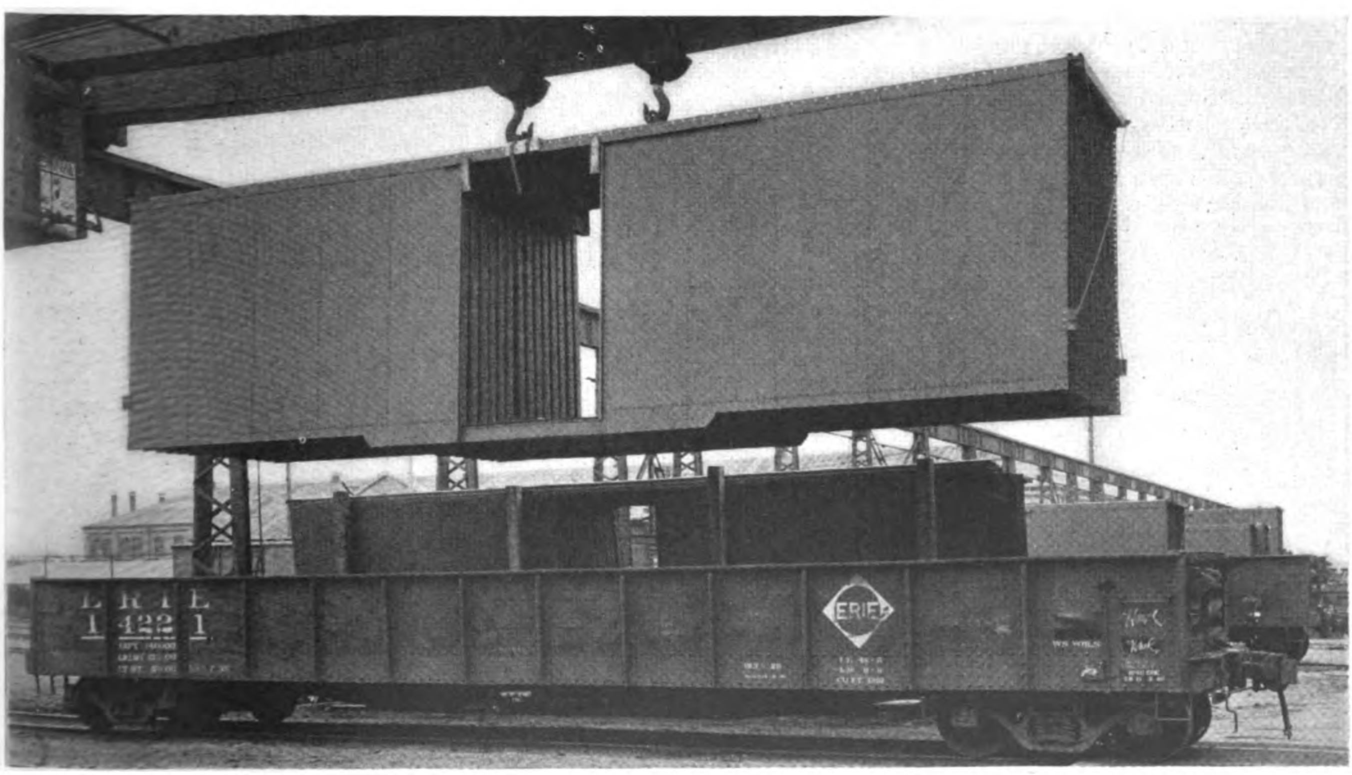
Line up of work on new 50-ton box cars at the Havelock, Neb., shops of the C. B. & Q.

Operations in Building New 50-Ton Box Cars at Havelock Shops

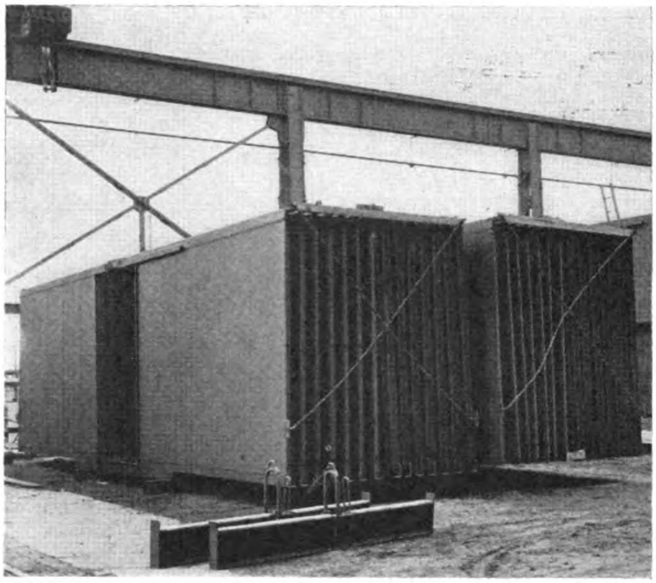
Station No.	Operation Performed
1	Assemble underframe on trucks; riveting, 50-ton Hanna riveters
2	Apply side sheets and ends
3	Apply side and end ladders; apply doors and door tracks
4	Fit up and rivet ends and top corner gussets; fabricate roof adjacent to No. 4 position
5	Riveting under center of car
6	Riveting sides, ends, underframe, etc.
7	Apply and ream roof and paint
8	Apply brake equipment
9	Apply scaffolds for roof riveters
10	Riveting roof
11	Miscellaneous welding such as corners
12	Air brake tests; sand blast and cement (outside of shop)
13	Floor fillers applied, flooring placed in car
14	Lay floor and door post fillers
15	Drill floor
16	Bolt floor
17	Cement around ends of floor
18	Sub posts for side lining applied
19	Side lining applied and nailed
20	Ceiling applied
21	End lining applied
22	Ridge pole purlins and headers applied
23	Wash car outside
24	Sand floor and inspect car
25	Paint, stencil and inspect (in paint shop)

Work done outside the assembly line:
Truck station; wheel plant; punch plates; bolsters and diaphragms; fit up and weld center sills; assemble and ream underframe; rivet underframe; apply draft gears; weld underframe; mill room; crane operators; cleaning cars and shop.

tion of both welding and riveting, are of the double-sheathed type with wood inside lining and conform in all essentials to Association of American Railroad standards, as regards size and standards specified for cars for interchange service. These particular cars have an inside length of 40 ft. 6 in.; width of 9 ft. 2 in., and height from



Method of unloading Youngstown steel sides at Havelock shops



Arrangement of tie rods to keep car sides together for unit-load handling—Two lifting cars are shown in foreground

floor to ceiling eaves of 10 ft. 6 in., which gives a cubic capacity of 3,898 cu. ft. The light weight of the car is 46,300 lb. and the load limit, 122,700 lb.

Minor changes from A. A. R. standard construction include, among other features: strengthening the side-sill reinforcement connection to the bolster diaphragms; improving the floor-beam connection to the side sills and the side-sill reinforcement to the outside of the door posts; stiffening the door posts; doubling the number of stringers between bolsters; providing ¼-in. Douglas fir plywood ceilings and ¾-in. plywood end lining, etc. A limited amount of high-tensile, low-alloy corrosion-resisting steel is used in such parts as bolster top cover plates, diagonal braces, stringers between crossbearers, center-sill separators, etc.

The first 100 of these cars are equipped with Allied Full-Cushion trucks. Fifty of these cars equipped with steam and air-signal lines, two-wear wrought-steel wheels and painted a dark Pullman green, were completed and placed in head-end passenger-train service in November, 1940, and gave an excellent account of themselves in the safe, smooth and fast handling of extensive express shipments on the Burlington during the year-end holiday season. Largely owing to special equipment used on the first 50 cars, the light weight of these cars is 49,900 lb.

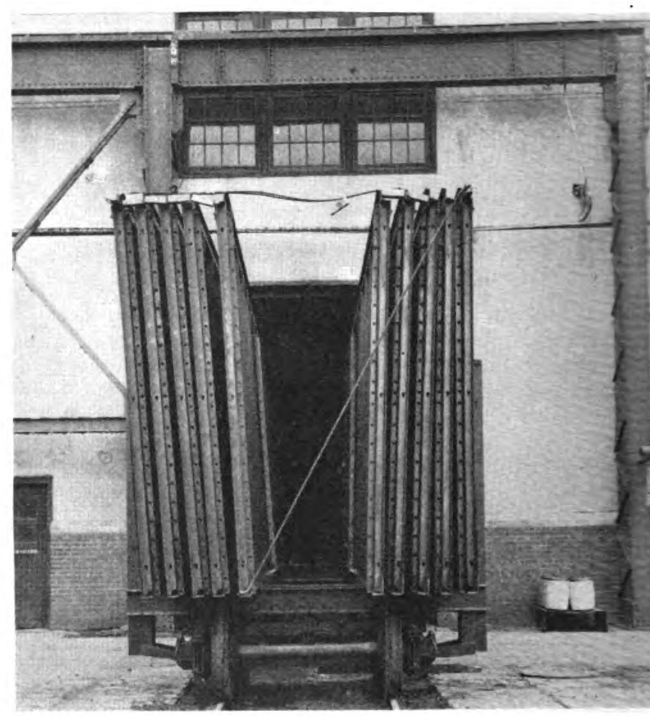
Underframe reaming device used at the Havelock car shop

All of the 1,000 new Burlington box cars are to be equipped with Youngstown all-steel sides, Dreadnaught two-piece steel ends, Murphy improved solid steel roofs, and Type AB brake equipment furnished by Westinghouse. A. A. R. approved freight-car draft gears of the following types are installed: Cardwell-Westinghouse, Edgewater, Miner, National, Peerless and Waugh. Both Camel and Creco-type single corrugated steel doors are used. Hand brakes are of the Ajax, Miner, or Universal "Non-Spin" types, designed to meet A. A. R. requirements. Royal slack adjusters are installed, either end- or side-operated.

Five different types of trucks are used, including Allied Full-Cushion trucks, Unit-type trucks, National Type-B trucks, Bettendorf and American Steel Foundries double-truss self-alining trucks. On all cars except the first fifty, 33-in. chilled-iron car wheels, weighing 750 lb. per wheel, are installed. Standard freight-car journal brasses and Cotton journal-box packing are used.

How the Cars Are Built

Reference to the drawing will show the general location of all important detail work as well as operations in



The car sides are moved into the shop on special dolly trucks

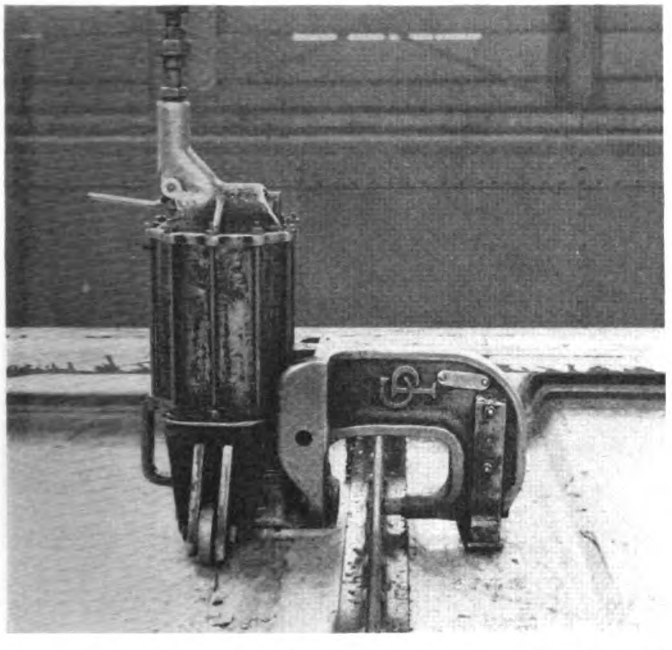
the assembly line at the Havelock car shops. Additional details regarding the work performed at each position are given in the table. Car assembly operations are performed in 24 positions on Tracks 2 and 3, all lumber moving to the assembly lines from Track 1 and all steel parts, such as wheels and axles, trucks, underframes, etc., coming from the machine shop. The east side of the shop is devoted to air brake work, a small mill room, tool room and electric repair shop, as shown in the drawing.

Underframe parts sheared and punched at the Galesburg, Ill., shops of the Burlington are shipped to Havelock and assembled by welding and riveting at the position shown in the drawing. When completed, these underframes are moved, one at a time, by the machine shop crane to the dolly and transfer track indicated at the north end of the shop, then being readily pushed into the erecting or assembly shop where it is picked up by

one of the two erecting cranes and mounted on its own trucks at position No. 1. Other operations at a total of 12 positions on Track 2 are performed as indicated on the drawing.

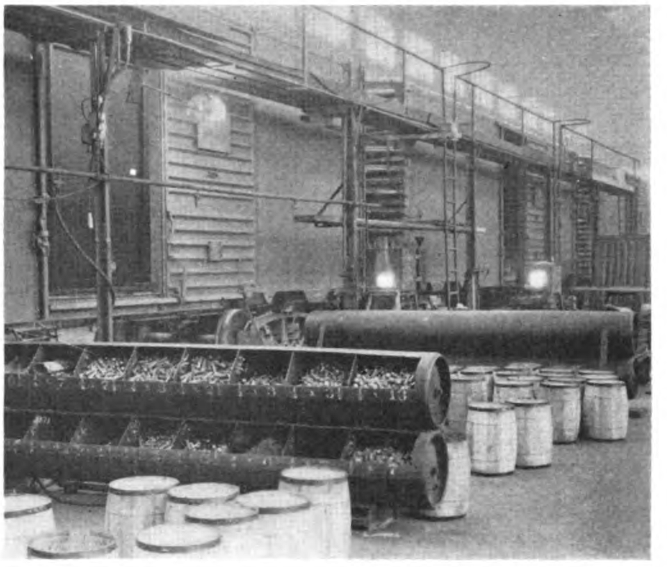
The entire line of coupled cars moves every 38 min., with suitable whistle warnings to enable all men to get clear. Electrically operated car pullers are located conveniently and one interesting feature is the provision of reverse pullers to drag the long heavy steel cable back into the shop by means of another small cable and thus avoid the necessity of having two or three men do this work by hand. The couplings between cars are sufficiently long to give adequate working room and, where single-plank platforms extend across scaffolds between the cars, these are counterbalanced so as to be easily swung up out of the way whenever the cars are being moved. One important feature of this shop is the provision of an adequate supply of working scaffolds of both the permanent and movable types, usually embodying welded tubular steel construction, which is both light and strong, and provided wherever feasible with safety guard rails.

From position No. 12, the cars move out of the shop at the south end on a track which has room for 12 cars and is equipped for sandblasting and priming the ends to assure a good paint job, also giving all underframe and inside steel superstructure parts a coating of protective car cement. It is necessary to hold about one day's output of cars on this track to give time for drying. During the sandblasting operation, the entire truck is protected with two sections of canvas, moved in, one from each side of the car. A switch engine is then used to switch these cars to Track 3, where they pass into the shop and through the various positions from No. 13 to No. 24, as shown on the drawing.



Chicago-Pneumatic roof riveting device equipped with rollers and sliding shoe for easy movement over car roofs

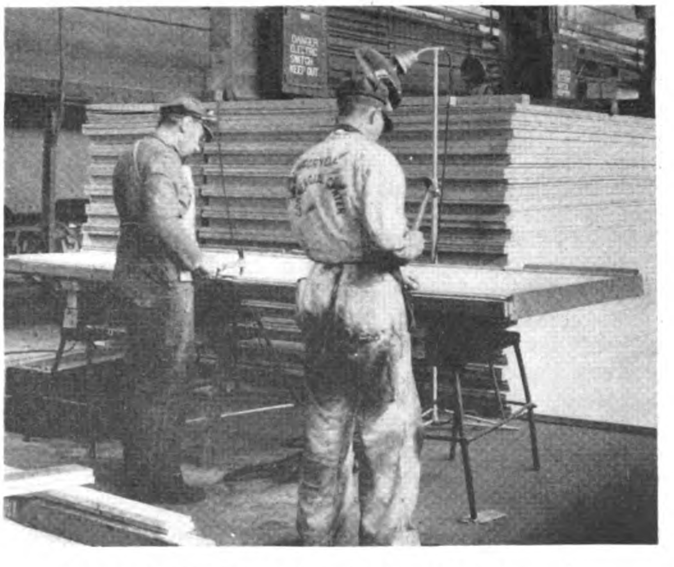
From Position 24 the cars move out of the car shop and are handled by a switcher to the paint shop where two coats of freight-car red synthetic enamel are applied, and the cars stencilled. The paint shop occupies about one-half of the old boiler shop and consists of two tracks under a low ceiling and side constructed of scrap car roof sheets. Three exhaust fans and one large ventilator fan are used to assure satisfactory ventilation and there are seven 10-in. heater pipes along one wall to maintain the proper temperature. In addition, experience having indicated that superior results are secured by not attempting to paint frosted steel surfaces, 50-ft. heating coils are installed at each of the first paint stations to assure rapid drying of the steel surfaces preparatory to painting. Another precaution to assure an exceptionally good paint job is washing down the car sides with mineral spirits at Position 23 in the car shop. The Youngstown steel car sides are, of course, given a priming coat before shipment.



Scaffolding arrangement at the riveting position—The rivets bins are scrap air reservoirs

In stencilling, paper stencils are applied to light metal and wood frames large enough to cover one-quarter of the car. The type of light, welded, steel scaffold and the fixed scaffold used in stencilling cars is clearly shown in one of the illustrations. Stencils are sprayed, a helper being employed to help handle the stencil and hold that part being used closely against the metal. Stencils are washed in mineral spirits twice a day, during the noon hour and at 5 p. m. Any necessary touch-up work is also done at the stencilling station.

From the paint shop the cars are moved by car pullers

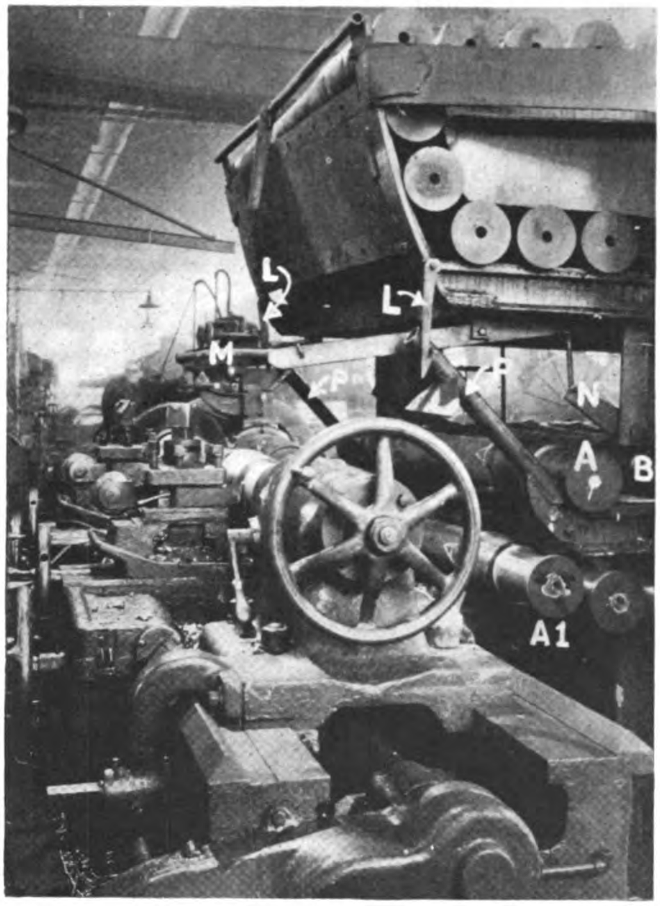


Jig used in applying battens to plywood ceiling panels

to the scales on an outside track for light weighing and completing the stencil. At this point the cars get final inspection and the application of commodity tags and door seals, ready for shipment.

What the Illustrations Show

One of the unique features of the present box-car construction program at Havelock shops is the way in which the Youngstown steel sides are handled from the car to storage in the shop yard under the gantry crane and thence to the shop where they are applied to the car underframe. One of the views shows 14 of these straight and smooth car sides being lifted as a unit from the gondola car by means of the gantry crane and two lifting bars, or equalizers, applied through the doorway, one being placed as near as possible to each door post.

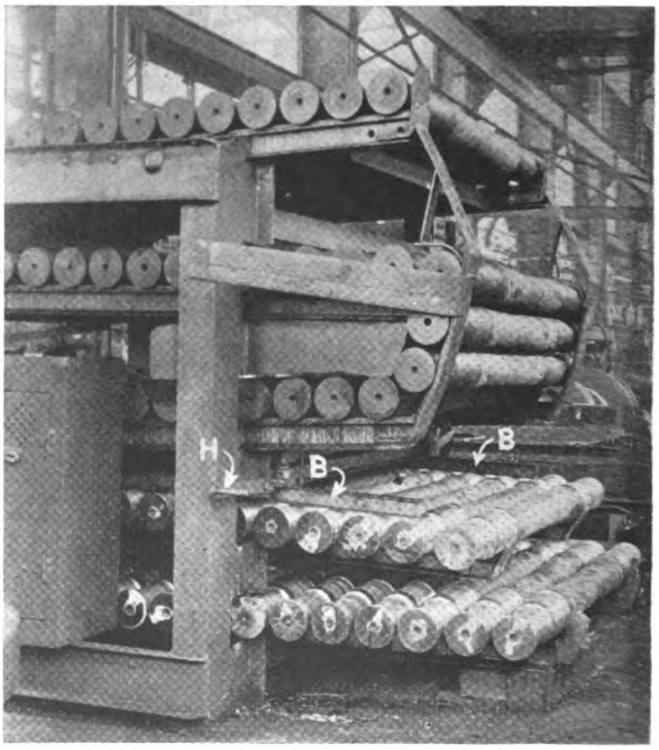


Axle lathe and special device used for automatically handling axles to and from the lathe

Before lifting the car sides, the diagonal tie rods at each end are disconnected from the gondola car and each fastened to one of the outside sheets by means of a small plate. This ties the entire load of car sides together and enables it to be handled as a unit instead of singly, which entails considerable extra time and expense. A close-up view of two loads of car sides in storage under the gantry crane is shown in a second illustration, which also gives a close-up view of the two lifting bars, made of 12-in. I-beams and equipped with a suitable clevice at the center of each for attachment to the crane hook and a stop plate welded to the I-beam at each end.

From storage the Youngstown steel sides are moved as a unit onto special dolly trucks shown in a third view, which consist of two car trucks equipped with 9-in. channels welded to the bolster side bearings and having vertical side channels of the same material welded to the bolster channels and braced at the bottom with short horizontal rods. On these dolly trucks, the car sides may be readily pushed into the shop, the end ties released and the sides handled one at a time by the shop crane with double hooks through door post holes to the desired position for application to the underframe. The use of a long, heavy and awkward walking beam is avoided by this method of handling the car sides.

Various other labor-saving devices are shown in the halftone illustrations. For example, on the underframe fabrication job, a very convenient tool is illustrated for reaming holes upward from the underside of the frame. This device consists of a Thor high-cycle electric motor mounted in a welded tubular frame, having two small wheels which provide easy portability and serve as a fulcrum to give the necessary upward pressure when the operator bears down on the handles. The handles are long enough to give a good leverage, the control switch is located on the right handle. The motor itself is not rigidly mounted in the frame but pivots on two bolts, one of which is shown, the point of suspension being slightly above the center of gravity so that the motor always keeps an approximately vertical position. The frame of this device is equipped with a small tubular container which forms a convenient receptacle for necessary reamers or drills.



Rear view of the axle device showing how axles may be loaded at the top level and delivered at the bottom after machining

For reaming horizontal holes through diaphragms and center sills an extension reamer with 4-ft. sockets is used to enable the operator to ream the hole while standing in a comfortable position just outside the car underframe and thus avoiding the necessity of crawling under it.

Another illustration shows a roof-riveting machine which consists of a Chicago Pneumatic squeeze riveter and is used for driving the horizontal rivets which hold the roof caps and sheets together. This riveter is equipped

(*Continued on page 66*)

Vaughn Hawthorne Promoted

V. R. Hawthorne, Executive Vice-Chairman

A. C. Browning succeeds him as secretary of the Mechanical Division A. A. R.

A. C. Browning, Secretary

THE long and constructive service of Vaughn Rue Hawthorne as secretary of the Mechanical Division of the Association of American Railroads has been recognized by his election to the newly created position of executive vice-chairman of that Division. Arthur Clark Browning, who has been associated with him as assistant to the secretary of the Division for many years, has been promoted to secretary. Changing conditions have very greatly increased the complexity and scope of operations of the Mechanical Division and Mr. Hawthorne's promotion is not only a well earned tribute to him, but also recognizes the enlargement and growing importance of the activities of the Division.

Mr. Hawthorne's association with the Mechanical Division took place under unusually trying circumstances. When Joseph W. Taylor, who, after 19 years of service as secretary of the American Railway Master Mechanics' and Master Car Builders' Associations, passed away in April, 1918, Mr. Hawthorne was made acting secretary. Coming into this position during the World War, when the railroad mechanical departments were operating under severe and unusual conditions, he found himself, a year later, faced with the task of going through a period of reorganization, when these two associations were merged to become what was then known as Section III—Mechanical, American Railroad Association.

It became necessary to thoroughly reorganize the work of the secretary's office. This he did "with energy and tact and with a vision of the future possibilities of a larger mechanical association." This quotation is taken from the Daily Railway Age of June 25, 1919. Its prediction of a larger mechanical association has certainly been fulfilled and that Mr. Hawthorne has met the greater responsibilities with success is indicated by the action that the General Committee has taken in advancing him to the newly created office.

Vaughn Rue Hawthorne was born at Oleona, Pa., November 27, 1886. After completing his high school education he attended the Elmira Free Academy, Elmira, N. Y. He entered the service of the Pennsylvania Railroad in June, 1904, as assistant storekeeper at Elmira. A year later he became a laborer in the Elmira shop of that road. After a short time he was promoted to car

repairer at Baltimore, Md. In 1907 he was appointed M. C. B. clerk at Baltimore and was later transferred to Williamsport, Pa., and then to Altoona, where he became lead clerk in the M. C. B. clearing house. He was promoted to M. C. B. inspector in 1915. In 1917 he went with the American Railway Association (now A. A. R.) as an inspector. In the spring of 1918, upon the death of Joseph W. Taylor, Mr. Hawthorne became acting secretary of the Master Car Builders' Association and the American Railway Master Mechanics' Association. In 1919 he was appointed secretary, when the two associations were combined as Section III—Mechanical, American Railroad Association.

A. C. Browning

Arthur Clark Browning was born at Belpre, Ohio, on July 15, 1884. He entered railroad service in January, 1906, as a trucker in the Chicago freight house of the Chicago, Rock Island & Pacific. Three months later he was advanced to yard clerk and in May of the same year entered the Chicago local freight office where he served as clerk, stenographer, assistant accountant and chief tonnage clerk. He was moved to the general office of the same railroad in August, 1917, as inspector of weights and later was employed as fuel clerk and general clerk in the office of the auditor of disbursements.

Mr. Browning entered the service of the former Master Car Builders' and American Railway Master Mechanics' Association as a committee reporter on February 16, 1919, shortly before their amalgamation as the Mechanical division of the American Railway Association, was made assistant to the secretary in July, 1919, and has served continuously in that capacity except for three years as a traveling mechanical inspector. For the past eight years he has edited the interchange rules and supervised matters pertaining thereto in the secretary's office, coming under the jurisdiction of the Arbitration committee and the Committee on Prices for Labor and Materials.

C. B. & Q. Builds A Thousand Box Cars

(*Continued from page 64*)

with a pair of rollers under the cylinder end and a shoe at the outer end which are designed to keep the dies in line with the center of the rivet hole in any position on the cap without raising or lowering the riveter. The riveter, thus equipped, can be readily moved to any desired position on the roof sheet and brought in line much quicker than would be possible with the overhead rail or balancing device ordinarily used.

At the riveting position, the furnace equipment, scrap air reservoirs partitioned off to hold various sizes of rivets, and the scaffolding arrangement are clearly shown in another of the illustrations. Still another view shows the jig used in applying battens to the 44-in. by 9-ft. 3¼-in. ceiling panels made of Douglas fir plywood. The panels are placed in this jig one at a time for the application of four battens per panel, a metal plate being built into the base of the jig at the near edge to clinch the nails as driven. Before applying the ceiling panels, the ridge pole and two sets of purlins are secured to the roof by bolts and metal clips. The ceiling panels are then applied, light and easily portable scaffolds being used to assist in this work. In nailing the battens, the steel backing-up bar with a long pipe handle is pushed in between the plywood and the car roof until it is over the transverse joint and the battens can then be nailed with every assurance that the nails will be clinched. Sub ridge poles and purlins are applied, the holding nuts being counter-sunk and filled in with plastic wood to give a finished appearance.

Car Axle Handling Device

To conserve floor space which is at a premium at the Havelock car shop, a unique car-axle handling device has been developed and installed which not only saves space but enables axles to be handled into and out of the axle lathe with practically no hand labor whatever. In this device, axles are loaded by crane on top of the machine and roll by gravity under suitable controls through five levels of a heavy steel-frame structure, made of 20-in. I-beam posts, 9-in. cross channels, 6-in. side channels and 110-lb. rail sections, the overall length, width and height being 11½ ft., 10 ft., and 8 ft., respectively. The axles are loaded by crane on the upper or fifth-level rails which have a slight incline and conduct the axles by gravity to an end plate which guides them to the fourth-level rails and similarly to the third-level rails which conduct the axles to the axle lathe at the same elevation as the lathe centers.

Referring to the axle lathe view, the operator releases two latches, *LL*, permitting the 28-in. extension bars *PP* (made of 2-in. pipe), to drop to a horizontal position and enable axle *A* to roll directly onto the lathe at a position very closely in line with the centers. A few revolutions of the hand wheel in the tail stock raises the axle slightly until it is supported between the lathe centers. After necessary machining operations are performed, a partial revolution of the hand wheel withdraws the nearer lathe center and a few more revolutions causes a hook attached to the tail center sleeve to engage the journal collar and pull the axle off the other dead center. The axle then drops by its own weight to a sheet-metal pan and rolls to the position shown at A_1 on the second level rails.

In the meantime, the pipe sections *PP* have been raised and latched and the operator exerts a lifting pressure on bar *M* which presses down lever *N*, the lower end of which serves as a stop to hold back the balance of the axles in the rack. When this stop is raised axle *B* rolls forward to position *A* and is then ready for handling to the axle lathe. Other axles in the rack follow axle *B* by gravity so that the only handling required is to load the axle rack by crane delivery of axles to the fifth level.

Referring to the second view of this device, the finished axles are delivered down the supporting bars at the second level, being retarded or stopped at the outer end by two positive stops and by brake bars *BB*, the pressure of which on the axles can be controlled by pressing down or releasing handle *H*. The first level supporting bars are used for temporary storage of the finished axles while waiting to be mounted.

This axle rack holds 55 axles ready for delivery to the lathe and 40 machined axles. It is designed for 5½-in. by 10-in. axles which are received rough-turned from the steel mills. The operation performed in the axle lathe, illustrated, consists simply of turning the wheel seats and on this work the production is about 51 axles in 24 hrs. Car wheels for this number of axles are bored and mounted on one 5-hr. shift and the wheels and axles then move to another lathe where journals are finish turned and rolled.

Highway Patriotism?—The various groups in Washington, interested in securing large federal appropriations for their particular hobbies, have shown no disposition to moderate their demands—to enable the government to concentrate its expenditures on the defense effort. According to an Associated Press dispatch on December 30, "highway construction advocates have gone ahead with plans calling for little if any reduction."

EDITORIALS

Mechanical Association Conventions

The editorial comment in our January number, entitled, Mechanical Associations Frankly Challenged, has stirred up some interesting and also some unexpected reactions. The Car Department Officers' Association, as an example, in a statement on another page, courteously but, nevertheless, firmly takes exception to our use of the word "challenged." Cutting the length of the meetings from four to two days it says, "may be considered more of a suggestion for greater efficiency than a challenge." Fine! The officers of that association have already started to roll up their sleeves and the Master Boiler Makers may have to look to it to maintain their record for long and strenuous sessions.

Most of the comments that we have received, and we are able to publish only typical ones, are strongly for preprinting the reports and distributing them far enough in advance of the meetings so that they may be studied and digested. There seems to be a little question about this procedure in the minds of the Car Department Officers' Association. If you don't do this, however, and if you send advance copies of the reports to only a few of the key members, will it not be necessary to read the reports in full at the meetings, instead of presenting them in brief abstract? Moreover, if the members have the reports in advance and understand that all of the time at the meetings will be used for discussion purposes, will it not be likely to draw a heavier attendance, and will the meetings not be much more interesting? Is it not true that most of the members are not trained to follow reports critically when they are read to them, whereas, if they have studied them in advance they are quite likely to follow the discussions on the floor with keen zest. This is particularly true if key men are asked in advance to "break the ice" and get the discussions started promptly.

Reports from the field indicate that before we went to press three of the associations had already held meetings of their officers to revamp their programs to fit into the two-day schedule. They have also made plans to speed up the committee work, in order to insure the completion of the reports by the middle of June. This will allow ample time for printing and mailing, so that they will reach the members far enough in advance of the conventions to be carefully read and studied.

Meanwhile, the *Railway Mechanical Engineer* plans to maintain close touch with the associations and to keep its columns open during the coming months for suggestions from our readers as to how they believe the meetings can be made of maximum practical benefit to them. Two pertinent communications will also be found on "The Reader's Page" of this number.

Diesel Installations Hit High Mark in 1940

From the standpoint of progress in the installation of Diesel motive power in railroad service the year 1940 was of exceptional interest for several reasons. During last year the railroads of the United States placed in service a greater number of Diesel-powered locomotives than in any year since the first Diesel switcher was installed in 1925; the total number of units installed in 1940—410—was almost double that of the previous year, which in itself was a record year; the number of units in road service—70—was almost equal to the total of the previous five-year period and the total horsepower installed exceeded the total of the previous five-year period; the total number of units now in service—1,011—have an aggregate engine horsepower of 1,006,320; the year 1940 witnessed the installation of eight units of 21,600 aggregate horsepower in main-line freight service on Class I roads.

The influence of the Diesel locomotive in the switching field has been particularly interesting. In the January, 1940, issue, the progress of the Diesel in that class of service was analyzed and it may be worth while to summarize the analysis made at that time as an indication of future trends. At the end of 1925, the year in which the first Diesel switcher was installed, there were three Diesel switchers having a total of 1,200 hp. in service. At the same time there were 10,702 steam switchers having an aggregate tractive force of 361 million pounds. In 1930 the total number of Diesel switchers had increased to 73 with an aggregate horsepower of 26,940.

The year 1930 seems significant in relation to steam switchers for that was the high point in aggregate tractive force—387 million pounds—in spite of the fact that ownership of that type of switching power had by then decreased to 10,268. In the six-year period ending with 1930 the roads had ordered over 800 steam switchers of increasingly high capacity, which accounted for the high aggregate tractive force with a decreasing total ownership. From 1930 the retirements of steam switchers and the fact that only 108 units of that type have been ordered in the last 10 years have resulted in a constantly decreasing ownership and aggregate tractive force.

At the end of 1934 the Diesel switchers in service totaled 113 with a total engine-horsepower of 47,600 and the comparative figures for steam switchers was 8,712 owned with an aggregate tractive force of 342 million pounds. During the five-year period ending December 31, 1939, there were 488 Diesel switchers installed bringing the total horsepower to 397,380 lb. and 93 steam switchers were ordered and 1,203 retired resulting in an aggregate tractive force of 306 million pounds for that class of power.

At the end of 1940 there were 941 Diesel switchers in service with a total engine horsepower of 638,020. The average Diesel locomotive horsepower has increased from 450 in 1929 to 678 in 1940. As of June 30, 1940, the ownership of steam switchers had further decreased to a total of 7,395 with an aggregate tractive force of 303 million pounds.

Between 1930 and 1940 the total ownership of steam switchers was reduced by about 2,800, and the ownership of Diesel switchers was increased to over 900. The reduction in aggregate tractive force of steam switchers, during the same period, was about 84 million pounds. At an average of 53,700 lb. about 50 million pounds of aggregate tractive force was replaced by the introduction of the 900 Diesel units. An appraisal of these two sets of figures would seem to bear out the estimate that a Diesel switcher will replace between two and three steam units.

To complete the record, the installation of 70 road Diesel locomotives in 1940 brought the total of road locomotives of this type up to 143 having a total engine horsepower of 368,300. The average road Diesel locomotive has 2,580 hp.

Signs of Preparation

In the January issue attention was called to the probable trend of freight traffic and car loadings during 1941. It was roughly estimated that to handle successfully a prospective fall peak averaging 900,000 or more carloads weekly for the four highest weeks, the Class I roads would need a net increase of at least 40,000 more freight cars than they owned at the time of last fall's peak. Based on the rate at which retirements have been continued during a number of years past, this would require the acquisition of as many as 100,000 new cars.

To increase in the number and aggregate capacity of freight cars owned by the Class I railways has required a reversal of the trend in ownership, which has been consistently downward ever since the beginning of the depression; indeed, it had started down even before that. From the end of 1932 the number of Class I freight cars decreased from 2,172,000 to 1,672,000 at the end of 1939—a net reduction of 500,000 cars in seven years and a net reduction in carrying capacity of 18.9 million tons. The decline had been continuous both as to the number of cars owned and as to the aggregate tonnage capacity.

Considering box cars alone, the same situation had prevailed; that is, the record of decline in the number of cars as well as in their aggregate capacity had been unbroken. In the case of open-top cars there was one break in the downward trend. During 1937 there was an increase of several thousand open-top cars and an even greater proportionate increase in aggregate capacity tonnage. The downward trend was resumed the next year, however, and continued until the end of 1939.

Last year occurred the first sign of a reversal in this downward trend in freight-car capacity. Car Service Division reports show an increase in the total cars on line of the Class I railways of over 6,600 between January 1 and June 30, and an increase in aggregate tonnage capacity of 614 thousand. During this period retirements amounted to over 36,000 cars, which is at a rate equal to the average of the three years 1937 to 1939, inclusive.

If these results of the actions of the railroads in 1940 may be considered any criterion of the policies which they will carry out during 1941, it seems evident that there will be no sharp curtailment of retirements and that new cars will be ordered in sufficient numbers to meet the needs of the railways for a continuance and acceleration of the net expansion of freight car capacity which began last year.

A Boiler Of Unusual Proportions

On another page in this issue is a description of an articulated freight locomotive for the Western Maryland, the boiler of which is of unusual interest. The article in question points out several noteworthy features of construction; it is to the proportions of the boiler that attention is directed here.

The firebox is over 17 ft. in length at the mud ring and a combustion chamber extends into the boiler barrel an additional 8 ft. With the Gaines wall in place the combustion chamber is approximately 11½ ft. long from the back of the wall to the tube sheet. The firebox thus has an unusually large combustion volume. With the five Thermic syphons—three in the firebox and two in the combustion chamber—the proportion of total heating surface in the firebox is the largest of any articulated locomotive built in recent years. The total firebox and combustion-chamber heating surface amounts to 10.61 per cent of the combined heating surface. The closest approach to this by any other locomotive is the Northern Pacific 4-6-6-4 type, the first of which were built some four years ago. Here the firebox heating surface constitutes 10.56 per cent of the combined heating surface. Probably considerably more

than half of the total evaporation will be effected by firebox and combustion chamber heating surface, which in turn means a high average evaporation per square foot of total evaporative heating surface.

Taking Guess Work Out of Front-End Design

She doesn't steam! She "chokes" herself! What to do? Why, change the exhaust nozzle, of course, or perhaps the stack extension needs adjusting. Too frequently, this has been the solution, regardless of the cause, to such a report from the engine crew or the travelling engineer. Though faulty operation, improper firing practices, poor grate design, and other factors may have been responsible, the exhaust nozzle is often the "scapegoat" and, at the same time, the "cure-all" for a poor performance.

Concealed from prying eyes, the action of the gases and exhaust steam inside the smokebox has always aroused the curiosity of those concerned with locomotive design and operation. For practical reasons, a knowledge of the effect of changes in the front-end arrangement is more important than knowing the details of just what takes place before the gases and steam are finally exhausted to the atmosphere. As a means for studying the effect of various front-end designs on boiler performance and exhaust steam pressure, the report on standing locomotive tests developed by the New York Central and presented before the annual meeting of the Railway Fuel and Travelling Engineers' Association last fall in Chicago, the first part of which appears elsewhere in this issue, deserves the attention of those interested in improving boiler and engine efficiencies.

In an effort to duplicate road conditions in the standing tests, the New York Central devised a method for controlling the temperature as well as the pressure of the exhaust steam. That it succeeded in doing so is indicated by a comparison of standing test results with those of an actual dynamometer car road test of the same locomotive. The results are almost identical. This is of importance because of the many times that road performances have failed to meet those obtained under test conditions. The investigation of front-end design by this method has distinct advantages as the effect of minor changes can be determined without incurring the inconveniences or cost of road tests.

The detailed study of the many parts in the front-end arrangement, both separately and in their relation to each other, made possible by the standing tests resulted in a remarkable improvement in the boiler evaporation and a decrease in the exhaust steam pressure. Changes in the size of the exhaust nozzle were not dictated by the whims of the engine crew or the fancied notions of a travelling engineer. The design of each part had to prove itself under scientific observation before it was accepted as that producing the greatest efficiency.

The standing locomotive tests showed that a change in one detail or dimension of the component parts definitely affects the performance of the others. Changing one part requires corresponding adjustments in others, if they are all to produce maximum efficiency. This explains why, once tinkering has been permitted, improvements in the performance of individual locomotives can be effected by further tinkering, even though the final result will be much below the best. After developing a satisfactory front-end design care should be exercised to see that the standard is strictly maintained even though it may require a lock on the smokebox door.

New Books

MASTERING MOMENTUM. *By Lewis K. Sillcox, D. Sc. Published by the Simmons-Boardman Publishing Corporation, New York. 274 pages, 130 illustrations, 6 in. by 9 in. Cloth binding, $2.50.*

This volume is an adaptation of material contained in six papers privately published and presented under the general title "Mastering Momentum" at the Massachusetts Institute of Technology over a period of several years. There are six chapters. The first, and by far the most extensive, deals with the mechanics of train operation and train braking. This is a condensed survey of braking developments and braking problems. In it will be found descriptions of methods employed in calculation of stopping time and distance curves as well as those involved in the operation of the brake itself. Other chapters deal with railway car wheels, railway car axles, locomotive and car-truck design, and draft gears. Each chapter contains a wealth of information of value to the student. Much of it is also valuable reference material for those engineers not specialists in the subjects treated. The reference value of the book is enhanced by a topical index.

FUELS AND THEIR UTILIZATION. *By A. R. Carr, dean of the College of Engineering, and C. W. Selheimer, assistant professor of chemical engineering, Wayne University, Detroit, Mich. Published by the Pitman Publishing Corporation, Two West Forty-fifth street, New York. 184 pages, illustrated. 6 in. by 9 in. Price, $2.*

No attempt is made in this book to go fully into thermodynamics, but the various fuels which, in current practice, are available for the production of heat, the means by which they are utilized for this purpose, and modern investigations and tests to increase and maintain efficiency in the production of heat are fully discussed, with particular attention to both principles and applications. Fuels, both liquid and solid, are classified, and their properties and characteristics described. Chapter II is devoted to laboratory experiments.

Suggestions for Mechanical Associations

Someone to Start Discussion

The one thing that struck me most forcibly at the Car Department Officers' convention, which I attended, was the manner in which the discussion was opened up. Probably this association is the one you had reference to, as they seemed to have a man ready to start each discussion.

Closer Co-ordination Suggested

The consolidated conventions should have a general subject committee to line up a co-ordinated plan. It is my thought that there should be more joint sessions where prominent speakers should address the entire convention, and probably have a consolidated banquet with a dinner speaker. When I refer to "prominent speakers" I have in mind men who can make a "speech" and not "read a paper."

Portable "Mikes"

There is one suggestion which I would like to present for your consideration. You know, from having taken an active part in the meetings, that the chairman usually insists that the microphone be used by anyone taking part in the discussion. I consider this essential for any meeting involving the number present at meetings of this association [Fuel and Traveling Engineers]. However, some valuable discussion is probably lost because of the hesitancy of some the members to walk to the platform and speak into the microphone. If one or two portable microphones attached to long leads were available so that they could be quickly handed to any member wishing to take part in the discussion, the remarks would probably be more lively, interesting, and would not necessarily consume more time.

Equipment Failures And Train Detentions

During the past decade I have witnessed many changes in the railroad industry, particularly with respect to car department matters, and it is apparent that the Car Department Officers' Association is doing a fine job in bringing valuable information to its members. Our young men are certainly given every opportunity to acquire knowledge and it seems to me we should do our part to encourage them in their work and inspire in these young men the will and desire to promote greater efficiency in their specialized fields. While many boys will come to us with a fund of technical knowledge, they will lack in experience and that is where we must not fail them.

I was particularly interested in the discussion on equipment failures causing train detentions, notably the high percentage of failures attributable to hot boxes. For many years railroads have had this serious problem to deal with, and will continue to have, though perhaps to a lesser extent, just so long as we have the present journal box assembly. Nevertheless, it has been our experience that such failures can be greatly minimized by insisting upon proper preparation and application of packing and careful attention to other details, as set out in A. A. R. Rule 66. To attain that objective, however, there must be constant policing to see that shop, yard and renovation practices are of continued high order.

Practical Value of the Conventions

The writer was educated as a civil engineer, but during the past twenty years has devoted a large share of his time to the study of boiler feedwater treatment and particularly the effect of good water, as far as improved locomotive operation is concerned. From personal contact with the men directly responsible for boiler conditions, I can see a great need for men who have imagination, vision and new ideas. There seems to be no better place where the men, who necessarily spend a large share of their time in the smoke and soot of a roundhouse, can enlarge their ideas to better advantage than by attendance at meetings of this kind.

The advantage of any convention is not primarily in listening to the formal reports, but rather in taking part and hearing the discussion which the reports bring out. Another valuable advantage is by reason of the contacts which these men make with men from other railroads and other districts of the country, who have similar problems but look at them from a different angle. I have personally noticed how men who never attracted attention before, blossom out with new ideas—and how they quickly advocate improved practices which they heard some co-worker from a distant railroad describe at the convention they attended.

Sending a man to a convention and instructing him to make a report at the next general mechanical meeting in his district goes a long way toward the development of a good man. As I listened to some of the discussions, I realized that each man was talking from the bottom of his heart about things of vital concern to his work, to his railroad and to his job, and what can be more worth while? Let no one think that a convention trip is just one of pleasure for those men who are really accomplishing things on the railroad. The right men attending a convention work much harder than they would at their regular routine, and never fail to bring back good ideas both for themselves and for their employers.

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Comments from readers on suggestions made in our November, 1940, number for making more effective the efforts of the Mechanical Department Associations. ***See also January number, page 25.***

Two Good Suggestions

Your editorial comments on the meetings were of great interest and value, particularly those concerning the starting of the meetings on time and the stimulation of discussions. It is suggested that these two matters be again stressed so that the meetings in 1941 will be of even more value than those of last October.

Concerning Speakers

The selection of a person to deliver a paper should depend upon a number of factors. Such a person, to be effective, should be not only as a matter of duty interested in his subject; he should, if possible, even be a "bug" on the subject. His interest should be vital, active, and his viewpoint different from the conventional. Further, he should be made to understand when approached for a paper, that what is of interest to an audience is not the hide-bound conventional viewpoint which everyone has been hearing for years, but new slants or radical perspectives, which may be foreign to his audience, but which will at least stir up interest and bring out discussion.

Short, Snappy Sessions

Your comment relative to starting meetings on time is timely, but I have always been a believer in short, snappy sessions. There are always some in attendance at conventions who are not interested in some of the subjects, but at the same time are very much interested in others. I believe that most sessions are too long to command the greatest interest. I believe that a two-day meeting, sessions starting at 10:00 a. m., adjourning at 12:30 p. m., reconvening at 2:00 p. m. and adjourning not later than 5:00 p. m., with all sessions opening and closing promptly, will do much toward getting members in their seats and keeping them there. You know, after all, the personal acquaintances that we make at these conventions are in some cases invaluable, and if you start meetings too early we don't have a chance to meet the men we would like to meet.

THE READER'S PAGE

Endorses Mechanical Associations

To the Editor:

Acting on your request for comment and suggestions concerning increasing the effectiveness of the railroad mechanical associations, I believe it may well be said, from observation of the activities of the several associations in convention, that they are fine organizations, doing work of the highest type. One interested in mechanical matters can only express commendation on the valuable service they strive to render and are doing in the field of railroad mechanics.

Apparently increased effectiveness and continued growth depends primarily upon three distinct factors: (1) leadership, (2) enthusiasm, (3) support.

However, to justify the need for existence there is a definite service obligation to meet, demanding careful choice of officers and thoughtful selection of active committees and topics for discussion.

The advantage of centralization of the conventions with an appropriate railway supply exhibit, as to time and place, is immediately apparent and will insure better attendance with correspondingly increased interest.

To extend the membership is essential, and endorsement of the true value of such associations by railroad mechanical department executives and the railroad managements is sought solely on the basis of tangible benefits accruing from membership participation. Recognition of factual benefits will bring needed co-operation and greater assurance for the provision of active membership.

Active participation in discussion is essential in committee deliberation and on the convention floor and should be further encouraged. Added interest in this respect may be aroused through the selection of key spokesmen. The individual member brings to the committees, and to the convention, an implied inquiry from his railroad for information and his interest and ability to absorb facts developed in such meetings will determine his representative value to that railroad and to the association.

The printed proceedings of these associations offer strong inducement for membership, presenting vast educational values to every progressive mechanical employee, far in excess of the nominal membership fee.

The future of these associations may be summed up thus: Their effectiveness is dependent upon combined individual effort and under continued efficient leadership will make an invaluable contribution to the railroad mechanical department.

Through your columns you can stimulate interest in these various organizations and urge the managements of the various railroads and private car lines to permit their supervisory officers to attend and participate in such association activities.

As one having attended some of their recent conventions, I appreciate this opportunity to comment from personal observation.

O. A. Garber,
Chief Mechanical Officer,
Missouri Pacific Lines,
St. Louis, Mo.

Car Department Officers' Comment

To the Editor:

Regarding the editorial which appeared in the January *Railway Mechanical Engineer,* entitled "Mechanical Associations Frankly Challenged," the action of the A. A. R. General Committee, in reducing the length of the convention to two days, may be considered more of a suggestion for greater efficiency than a challenge. In their daily occupations, railway car supervisors are continually finding it necessary to develop and adopt methods and procedure to increase efficiency. Surely the same deliberate goal should be sought in conducting the affairs and activities of the Car Department Officers' Association.

The C. D. O. A. program for the 1941 Fall meeting was rather completely developed before the action of the General Committee. Although it was built up with the thought that the convention would take more than two days, only subjects of importance and immediate urgency were included. As the situation looks now, there is but one answer. Start the sessions early; take less time out for lunch; and hold longer sessions, as is done at many individual railroad staff meetings. Let's make the 1941 convention another constructive and important inter-railroad staff meeting.

As to the pre-convention distribution of individual papers and committee reports, there are arguments both pro and con. Is it not likely that, if all of the papers are made available to all of the members in advance of the meeting, some members may feel that they do not need to attend? Would it not be better to make individual papers and reports available to a limited number of men capable of analyzing each and qualified to develop important supplementary information and join in the discussion on the floor? A number of C. D. O. A. officers believe that this policy will add to the value of the papers, develop a more representative experience and expedite the handling of the subjects.

As to the addresses, the general thought appears to be that they should not be eliminated entirely, thus taking from the programs much of the lasting inspiration that has characterized them in the past. Railway car men frequently take the published Proceedings and read one or more of the addresses which they heard at the last annual meeting. Even from the coldly impersonal type, they get inspiration from the words of the distinguished men in the railroad field who have graced the speaker's platform and presented words of experience and wisdom.

The officers and members of the C. D. O. A. can look back in the quite recent past to the accomplishment of a number of tasks much more imposing and difficult than that of "putting on" a successful two-day program at the annual meeting next Fall. The more they think about it, the more they are convinced that an opportunity is being presented to set up new standards in the effective organization and handling of annual meetings.

Publicity Committee
Car Department Officers' Association

"Then tell me," Evans laid the train-gram on Dirk's desk, "What in the hell is the meaning of this?"

A NEW BROOM

by **Walt Wyre**

"MAYBE we'll get a little service now," Jim Evans, roundhouse foreman for the S. P. & W., remarked when he learned that the division store department was to be moved to Plainville. "At least," he added, "we should be able to get two machine bolts of the same size and length without waiting for one of them to be ordered."

"Getting a new storekeeper, too," John Harris, the roundhouse clerk, said.

"Yes, a man by the name of Dirk," Evans replied. "Don't remember ever having heard of him." The foreman left the office and went to the roundhouse to see how things were going.

The new division storekeeper reached Plainville at 10:30 that morning and went directly to the roundhouse. He was in the storeroom office when Evans went to see about booster parts for the 5081.

"I'm the division storekeeper," Dirk said when Evans entered. "My name is Dirk," he added, thus implying that his title was more important than the name.

"Glad to know you, Mr. Dirk," Evans acknowledged the introduction. "What I'm interested in now is parts for the booster on the 5081."

"I'll get right after them," Dirk said. "Just as soon as I get straightened around, I'll look up the requisition and wire for them. I'll have them here right away."

While the two were talking, Ned Sparks, the electrician, came to the storeroom. "How about a half-inch LB condulet?" Sparks asked the counterman.

"Haven't got it," the counterman replied after he had looked.

"Let's see if you've got anything I can use." The electrician opened the gate and went to the electrical rack. "Guess this LR will do," he said. "Better change that requisition."

When the electrician had left, Dirk went out and snapped the lock on the gate to the storeroom. "No one but store department employees should be allowed in the storeroom," he told the counter man.

"Well, I guess I had better go," Evans said. Dirk didn't get the point until the foreman was half way back to the roundhouse.

The new storekeeper spent the rest of the day looking through the stock and commenting on the apparent inefficiency of his predecessor. Everything was arranged wrong; there was either too many or too few of every item. In fact, if Dirk noticed anything in the storeroom that was right, he failed to mention it. He was so busy finding things that needed correcting he forgot to order the parts that Evans was needing for the booster. Dirk was particularly annoyed when he found a miscellaneous assortment of material on top of a material rack in the rear of the storeroom. "What's all of this?" he asked the counterman.

"That's all charged out," the counterman replied. "They are parts that are not used often and the foreman charged them out so they wouldn't show in our stock. Makes the record book better by keeping the inventory low."

"Well, it won't be done that way any longer. If the mechanical department wants the stuff, let them take it to the roundhouse," Dirk said. "If they don't want it, ship it in for credit. We're not keeping dead stock in the storeroom. I want you to start tomorrow cleaning out everything that doesn't show consumption for the past sixty days."

"How's the new storekeeper?" John Harris asked when Evans returned to the roundhouse office.

"O. K., I guess," Evans replied. "He acts like he has a cockle burr under his tail, but seems to know his business."

The storeroom was a busy place the next few days, cleaning, painting, changing things around like a housewife on the first warm day of spring. And likewise, no one could find anything in the storeroom. A machinist sent to the storeroom for six ⅝ by 4 inch studs. After searching thirty minutes while the machinist and helper waited for the studs, the material man gave up and another hour was lost while a machinist made them on a lathe. Next day the studs were found where some one had misplaced them in a bin with ¾ in. studs.

Evans waited four days for the booster parts he needed and decided it was time the parts were showing up.

"They should be showing up any minute now," Dirk said. "I'll wire about them again. Come in and take a look at the storeroom," the storekeeper said to change the subject.

"Looks right nice," Evans commented, "but the parts for that booster would look better to me. Guess I'd better get back to the roundhouse and rush the boys up a little on the 5082," the foreman said as he left.

The foreman went to the roundhouse but didn't say anything to the men working on the 5082 because everything seemed to be going along nicely. The engine was over the drop pit for classified repairs. The machinist was just about ready to start putting the wheels up. Leaving well enough alone, the foreman started down through the house. The outbound inspector came rushing in looking for a pipefitter and saw the foreman.

"Air pipe broken on the 5076," the inspector panted. "It broke just as the crew started to run the engine out to get on the train."

Evans looked at his watch. "I'll go through the house and out to the engine. You go the other way. If you find a pipefitter, tell him to grab some tools and come running."

A pipefitter reached the engine almost as soon as the foreman. "We'll need a three-quarter street ell," he told the foreman.

Evans wrote out a requisition and handed it to the pipefitter's helper. The helper left at a run. Five minutes later the helper returned empty handed. "Didn't have any," he said.

"Why didn't you get an ell and a close nipple?" the pipefitter asked.

"The storeroom man wouldn't have let me have them, said he would have to have another requisition, order from the division storekeeper," the helper added.

"I'll get them," Evans said and sounded as though he meant exactly that.

There was a fifteen-minute terminal delay on account of the broken air pipe. Evans didn't exactly lose his temper, but he exercised it a bit.

Work on the 5082 was going along nicely. The first pair of drivers were up and the second pair on its way. Machinist Cox was under the engine watching to see that everything was in place. His helper was handling the push button switch. The motor was humming merrily, the table bearing the drivers was coming up, when Cox noticed that one of the driving boxes wasn't in line. "Stop it!" Cox yelled.

In order to stop quickly, the helper pressed the "down" button reversing the motor. Neither of the men noticed the slight rattle that followed when the motor was reversed.

The machinist straightened the driving box. "O. K., raise it up," he said.

The helper pressed the button. The motor started, but instead of running smoothly as before, there was a terrific rattle. The table jerked as though it were locked and the helper released the switch button.

"Sounds like a stripped gear," Cox said.

"Yes, I guess that's what happened," the helper agreed. "I noticed the fibre gear on the motor was getting pretty badly worn a few days ago."

The helper was right. The fibre gear on the motor was stripped. Only a little ring of teeth on one end was left on the gear.

"Take the guards off from around the gears," Cox told the helper. "I'll go tell the foreman."

"Well, it could be worse," Evans said. "It won't take long to put on a new gear and there's one in the storeroom. I ordered it six or eight months ago and gave the storekeeper a requisition for it when it came in. Go down to the storeroom and get it."

"What can I do for you?" the counterman at the storeroom asked when Cox entered.

"Give me the fibre gear for the drop-pit motor," Cox replied.

"Got a requisition?" the storeroom man asked.

"No; don't need any. It's already paid for, and I'm in a hurry," Cox added.

"Is the gear you want one that was on top of the last rack?"

"Yes, that's it, the fibre one," the machinist was beginning to get slightly impatient.

"If that's the one you want," the storeroom man said, "it's not there any more."

"What do you mean, not there?' Cox started to open the gate to enter the storeroom proper, but it was locked. He climbed up on the counter and slid down on the other side.

"Hey!" the counterman said. "The storekeeper will raise thunder if he sees you in here—nobody allowed in here but storeroom employees."

"Let him raise!" The nut-splitter continued walking towards the rear of the storeroom. "If you won't get the gear for me, I'll get it myself. Where is it?"

Division storekeeper Dirk in his adjoining office heard the loud talking in the storeroom and went to see what was causing the commotion. "Say, didn't I tell you not to allow any one to come in the storeroom but store department employees?" he said to the counterman.

"Yes, but——"

"He didn't do any allowing," Cox interrupted. "I just came in. Where are those gears for the drop pit?"

"When you want material just give your requisition to the man at the counter. He'll get it for you," Dirk said with emphasis.

"Say, listen, I'm not going over all of that again! Do I get the gear or not?"

"He means that fibre gear that we sent in," the counterman explained.

"You mean it's been sent in!" Cox exclaimed. "There'll be hell about that!"

"We can't keep dead material on hand," the storekeeper said, "if you needed that gear you should have taken it when it came in."

But Cox wasn't listening. He was already on his way back to the roundhouse.

A Missouri mule skinner could have learned some new wrinkles in streamlined profanity when Evans learned that the gear had been sent in. He was so mad he never even knew when he swallowed his chew of horseshoe. "First the parts don't get here for the booster, then the drop-pit breaks down and the storekeeper has sent the gear back! If that's railroading, I'll take jerking soda," the foreman complained, but Evans learned long ago that little is accomplished by idle talk. After the outburst he began to figure some way out of the predicament. He climbed down in the drop-pit and looked at the old gear.

"Get it off," he told the machinist, "and take it to the machine shop. And don't batter it up." Evans climbed out of the drop-pit and went to the storeroom.

It was characteristic of Evans that he said nothing to the storekeeper about the gear when he reached the storeroom. There were two reasons. He wanted time to cool off and time spent arguing would delay getting the drop-pit going. "Got any sheet fibre?" Evans asked.

"No," the man at the counter replied, "but the electrician has a big piece of it."

Evans went to the electric shop. The big piece of fibre was two feet square and three-quarters of an inch thick. The electrician had ordered it to make a test panel. "I'll tell the storekeeper to order another piece," Evans told the electrician.

When the foreman reached the machine shop he found Cox waiting with the damaged gear. Measurement of the strip that still had teeth left on it showed the gear to be slightly over nine inches in diameter and it was four inches thick.

"Not enough fibre," Cox commented.

"By putting a piece of brass half an inch thick on each side we can just make it," Evans said. "Take the fibre to the car department mill and cut out four circles about eleven inches in diameter. That will leave some material to work on."

While the machinist was cutting the fibre into discs, Evans had a machine man turn out two round brass plates exactly the diameter of the outside the gear was to be with holes in the center the same size as the motor shaft. The foreman then laid the two brass plates together and using washers to keep the bolt head and nut from slipping through the holes bolted the two brass plates securely to the old gear with the good edge of the gear next to the brass plates. With the old gear as a guide, holes were drilled between the gear teeth.

By the time the job was finished, Cox returned with the four fibre discs, but the foreman wasn't quite ready for them. Leaving the brass plates bolted to the old gear for a pattern, Evans told the machinist to cut the teeth in the brass plates.

It was slow tedious job sawing and filing the inch thick brass to the exact contour of the gear teeth. The five o'clock whistle blew before the job was finished but it was finally done.

Next the plates were bolted on either side of the four fibre discs using six half-inch bolts in a circle just below the bottom line of the teeth. A light coating of glue was applied to the fibre before being bolted together.

While the machinist was working on the gear, Evans went through the house, checked up his work reports and did a dozen other odd jobs that had to be done. At the roundhouse office the clerk told him the dispatcher was wanting an engine for an extra drag of empty reefers sometime the next day.

"Looks like we'll have to get the 5082 finished tonight," Evans said as he went back to the machine shop to see how work on the gear was progressing. Cox had it all bolted together when the foreman got there and was wondering what to do next.

"Take it to the drill press and drill an inch and a half hole through the fibre," Evans told him. "That will leave enough to true up. I'll go get a bolt to use for a mandrel to put it on to turn the outside."

The outside of the fibre was turned down to the diameter that the finished gear was to be, then taken off the mandrel, chucked, and the inch and a half hole bored out to the finished side to fit the motor shaft.

"Are we going to cut the teeth by hand like we did the brass?" Cox asked.

"No, take it to the drill press and drill out between the teeth like you did the brass, then take it down to the mill and saw out as much of the remaining fibre as you can on the band saw. Don't try to get too close, though, and let the saw hit the brass," Evans cautioned.

A coarse file was used to remove the remaining fibre and shape up the teeth, then a finer file was used to smooth them up.

"Makes a pretty good looking gear," Cox remarked as he was finishing smoothing the teeth. "How are we going to cut the key way?"

"Take four power hack-saw blades and bolt them together with stove bolts," Evans said. "Rough out the key way with them and square it up with a file."

The foreman stayed on the job until the gear was driven on the motor shaft and tried out. It was slightly noisy at first until the high spots wore off, but it worked. A night machinist finished putting up the wheels and the 5082 was ready for the drag at 2:30 the next day.

"Just got a wire about your booster parts," the division storekeeper told Evans that day. "They'll be shipped tomorrow."

"You said you'd get action," Evans replied. "I had just about given up hope of ever getting them."

"Everything is slow now. It's hard to get material with this defense program going on," Dirk said.

"Well, in that case, seems to me it might be a good idea to keep material that might be needed, instead of sending it back—the gear for the drop-pit motor, for example," Evans replied dryly.

Everything went along fairly well for the next two or three weeks. The material problem was about normal, then the gasoline-electric portable crane stripped the gears in the differential.

Several months before the machine had given trouble with the differential. It was torn down and the drive pinion found to have a tooth knocked out. The other gears were not in very good condition at the time but

there was a drive pinion in the storeroom and the other gears had to be ordered. The drive pinion was replaced and the other gears ordered. The portable crane continued to run and no convenient time could be found to put the gears in as long as the machine would operate, and the crane differential gears went along in the same car with the drop-pit gear.

Perhaps it was best for all concerned that the storekeeper was out when Evans went to the office. The foreman took the parts catalog and marked the gears to be ordered and showed the stockman just what he needed.

"O.K., I'll wire for them right now," the stockman promised.

Dirk came in just as the stockman had finished typing the message and laid it in the basket.

"What's that?" the division storekeeper asked.

The stockman explained about the gas-electric crane being tied up for parts and that the machine was badly needed.

"I'll handle it," Dirk said in a tone that indicated no one else was capable.

Evans waited two days then asked Dirk about the gears.

"They should be showing up any time now," the storekeeper said. "Maybe they are at the passenger station now."

They were not at the passenger station and there was nothing to indicate when the gears would be there.

In the meantime if the portable crane had ever been needed in the roundhouse at Plainville, it was needed then. In fact it seemed that there were more things to be moved than ever before and the crane was standing in one corner of the machine shop with its rear end resting on wooden blocks useless as a tissue paper parasol in a cloudburst.

Four days after the machine broke down Evans received a traingram from the roundhouse foreman at Middleton. "Have received a traingram from division storekeeper Dirk asking if we have gears in our motor car parts that can be used in gas-electric crane differential. There must be some mistake somewhere."

Evans read the traingram through twice before he got the meaning, then he headed for the storeroom.

"Did you wire for those differential gears for the portable crane?" Evans asked Dirk.

"Why, yes, I ordered them that day."

"Then tell me," Evans laid the traingram on Dirk's desk, "what in the hell is the meaning of this?"

"Why, they maintain two gas-electric motor cars at Middleton and I thought they might have some gears there that would do—might get them quicker."

Evans swallowed hard, bit his tongue, counted ten, and was still mad, but he managed to keep his voice even.

"Don't you know that rail motor cars don't have a differential? Even if they did, they wouldn't fit a portable crane. I marked the parts needed and saw the stockman start to make a wire ordering them, and I'm wondering why the wire wasn't sent."

"I've already wired for them," Dirk replied. "You don't seem to appreciate that I was trying to save time and money for the company."

"Well, this is the second time we have had unnecessary expense in the roundhouse because the store department sent in parts that I had ordered." Evans didn't raise his voice but his tone was hard.

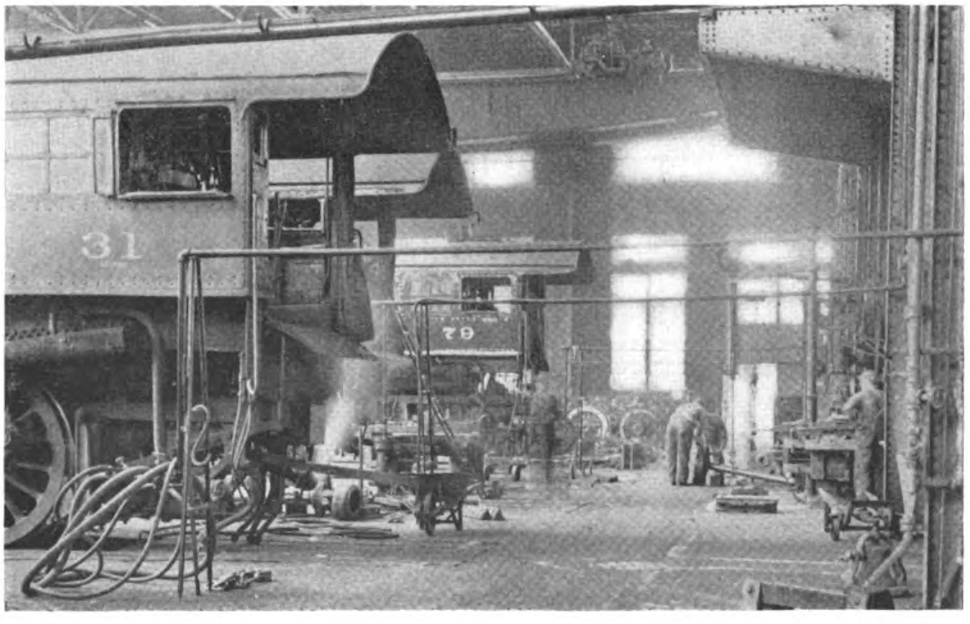
"The store department can't keep dead stock on hand. If material isn't used, we've got to sent it in. It makes our record look bad if we don't."

"Maybe I'm wrong," Evans said, "but you know I've always had an idea that the store department was operated to supply material for other departments, the mechanical department being one of them. Which is more important, a few dollars worth of dead stock in the storeroom or dead engines in the roundhouse waiting for parts?"

Evans left the office while Dirk was trying to think up a reply.

Supports and Racks For Welding Hose

Many railroad shops are so arranged that when oxygen and acetylene stations are installed they are located on columns across a runway or traffic lane from where the torches are to be used. This leaves the gas hose lying on the floor to be run over, cut and crushed by any of the numerous hand and electric trucks that travel this traffic lane each day. It is desirable to protect this hose in some manner, but more important to the welder is the elimination of the nuisance of having to stop in the middle of a job and repair a hose. This condition existed in one small New England shop and was allowed



Four of the welded A-frame supports for pipe and hose lines can be seen along erecting-shop aisle

to go until most of the hose lines in the shop were patched almost every two or three feet. Finally, a steel bridge was made to lay over the hose on the floor. This protected the hose but created a safety hazard because the plate was slippery to walk over and it made an uneven place for trucks to run over.

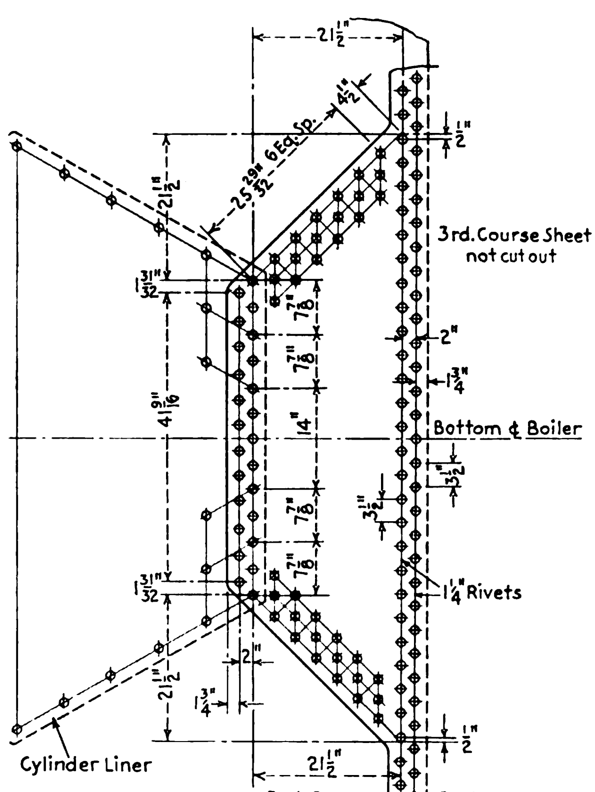
In this shop, on each of the columns bearing the gas stations there is also a water and steam outlet connection and these are piped across the runway when needed for filling and testing boilers and drying lagging. The pipe lines are put up and taken down as needed. The problem was solved satisfactorily by erecting a neat all-welded A-frame. Loops were made from 3/8-in. round iron and welded at 24-in. intervals along the top of the pipe making a place to lay the welding hose, thereby protecting it from the truck wheels and keeping it out of the way.

This method is now used for air hose, electric-light cords and city gas lines, and the floor is clear.

Pitted Area Repaired by Boiler Course Extension*

Pitted sheets are not uncommon in bad-water districts and the usual remedy is to apply new bottom half-course sheets if the pitting embraces a large area or a patch if the pitted area is small. Because of pits in the bottom of the second and third courses it was necessary to repair the boiler of a locomotive of the 2-8-8-2 type. In this boiler the pits in the second course were between the inside liner at the front boiler saddle location and the edge of the third course sheet. The pits in the third course were just ahead of the inside liner at the cylinder saddle.

* An entry in the prize competition on boiler patches announced in the March, 1939, issue. The names of the prize winners were published in the August, 1939, issue.



The application of the projection of the new second course to reinforce pitted area at the bottom of third course

The application of bottom half-course sheets was considered unsatisfactory as the longitudinal seams in both courses were diamond shaped and in combination with the inside bottom liners in these courses allowed for insufficient space for the two additional longitudinal seams required. Neither inside nor outside patches were practical due to the conditions imposed by the inside liners and the two saddles.

It was decided that the best method for making economical and satisfactory repairs to this boiler was to apply a new second course sheet with a projection extending over the outside of the third course to take care of the pitted area in that course. The illustration shows how this repair was made. While this is perhaps not a patch difficult to design or apply, it illustrates a boiler repair problem in which many conditions must be carefully considered in the drafting room.

Locomotive Boiler Questions and Answers

By George M. Davies

(This department is for the help of those who desire assistance on locomotive boiler problems. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless special permission is given to do so. Our readers in the boiler shop are invited to submit their problems for solution.)

Efficiency of Triple-Riveted Patch With Double Straps

Q.—What is the efficiency of a triple-riveted patch, with double straps, using 1-in. rivets, 8-in. pitch, 13/16-in. shell, with a tensile strength of 55,000 lb. per sq. in.? What effect does the length of the crack have on the efficiency?—D. E. D.

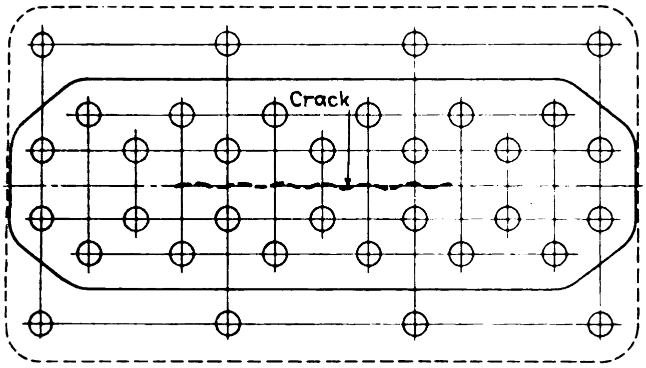
A.—The efficiency of a triple-riveted and double-strap patch as illustrated in the diagram should be computed in the same manner as for a triple-riveted and double-strap butt seam, as follows:

Where

TS = Tensile strength of plate, lb. per sq. in.
t = Thickness of plate, in.
b = Thickness of butt strap, in.
P = Pitch of rivets on row having greatest pitch, in.
d = Diameter of rivet after driving = diameter of rivet holes = 1 1/16 in.
a = Cross-sectional area of rivet after driving, sq. in.
s = Shearing strength of rivets in single shear = 44,000 lb. per sq. in.
S = Shearing strength of rivets in double shear = 88,000 lb. per sq. in.
c = Crushing strength of mild steel = 95,000 lb. per sq. in.
n = Number of rivets in single shear in a unit length of joint
N = Number of rivets in double shear in a unit length of joint

Then

A = Strength of solid plate $= P \times t \times TS = 8 \times .8125 \times 55{,}000 = 357{,}500$ lb.
B = Strength of plate between rivet holes in outer row $= (P - d) \times t \times TS = (8 - 1.0625)\ .8125 \times 55{,}000 = 310{,}019$ lb.
C = Shearing strength of four rivets in double shear, plus the shearing strength of one rivet in single shear $= N \times S \times a + n \times a \times s = 4 \times 88{,}000 \times .8866 + 1 \times 44{,}000 \times .8866 = 351{,}093$ lb.
D = Strength of plate between rivet holes in second row, plus the shearing strength of one rivet in single shear in the outer row $= (P - 2d)\ t \times TS + n \times s \times a = (8 - 2.125)\ .8125 \times 55{,}000 + 1 \times 44{,}000 \times .8866 = 301{,}549$ lb.



Triple-riveted patch with double straps

E = Strength of plate between rivet holes in the second row plus the crushing strength of butt strap in front of one rivet in outer row $= (P - 2d)\ t \times TS + d \times b \times c = (8 - 2.125)\ .8125 \times 55{,}000 + 1.0625 \times .8125 \times 95{,}000 = 344{,}550$ lb.

F = Crushing strength of plate in front of four rivets, plus the crushing strength of butt strap in front of one rivet $= N \times d \times t \times c + n \times d \times b \times c = 4 \times 1.0625 \times .8125 \times 95{,}000 + 1 \times 1.0625 \times .8125 \times 95{,}000 = 310{,}057$ lb.

G = Crushing strength of plate in front of four rivets, plus the shearing strength of one rivet in single shear $N \times d \times t \times c + n \times s \times a = 4 \times 1.0625 \times .8125 \times 95{,}000 + 1 \times 44{,}000 \times .8866 = 367{,}056$ lb.

Divide B, C, D, E, F or G (whichever is the least) by A and the quotient will be the efficiency of the patch. Efficiency of patch $= 301{,}549 \div 357{,}500 = 84.34$ per cent.

The length of the crack, when it is greater than the pitch of the outer row of rivets in the patch, would not affect the efficiency of the patch.

The length of the crack when it is less than the pitch of the outer row of rivets in the patch, would affect the above calculations in that the strength of the plate, i. e., (P—length of crack) $\times$ .8125 $\times$ 55,000 would be added to C, F and G, strengthening the patch at these points. However, it will be noted in the calculations that the weakest point of the seam is D, the strength of the plate between rivet holes in second row, plus the shearing strength of one rivet in single shear in the outer row. D would remain the weakest point of the seam as the strength of the solid plate remaining due to the length of the crack being less than P does not strengthen the patch at D.

Causes of Foaming in Boilers

Q—What are the causes of foaming in a locomotive boiler?—M. J. L.

A.—The use of caustic soda and soda ash in the water treatment is one of the chief causes of foaming; oil and grease carried into the boiler is another. The latter gets in the boiler when the exhaust steam from the cylinders is mixed with the boiler feed water in the feedwater heater without proper oil separation or when the exhaust steam from the various auxiliaries is condensed back into the tank with no provision for oil separation.

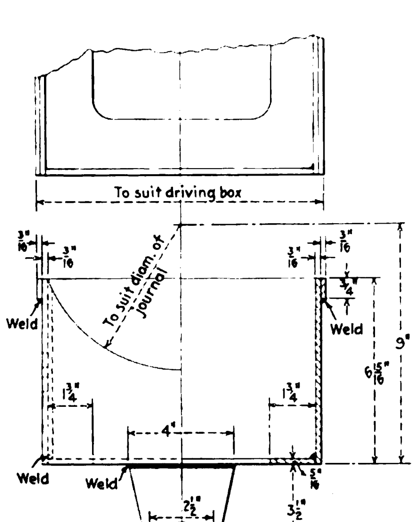
The presence of suspended solids or sludge in the boiler water also causes foaming. The theory is that highly divided particles tend to collect in the surface film surrounding the steam bubble and make it tougher. Consequently, when the steam bubble reaches the surface of the water it does not break but remains intact and builds up foam. This theory suggests that the finer the particles, the greater their collection in the bubble.

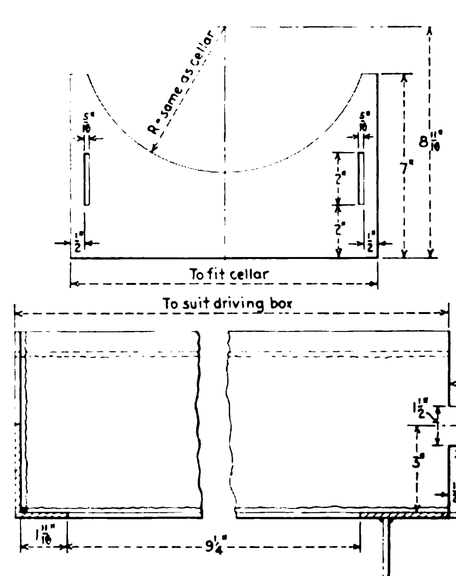
All-Welded Steel Grease Cellars

Whether or not many of the cast-iron grease cellars that are removed from the boxes in a broken condition may have been broken by the carelessness of workmen, it remains a fact that a great many are broken. The welding foreman in a small back shop on an eastern road developed an all-welded grease cellar that has been applied to many locomotives on that road and given satisfactory service.

The manner in which the cellar is made is shown in the accompanying drawings. The several pieces of the cellar, i. e., sides, ends, bottom and reinforcing strips may be flame-cut if other equipment is not available. The joints between sides, end and bottom are welded. The slots in the separate end plate are so spaced that it will slip onto the lugs on the cellar without difficulty. Small S-hooks are used to hold the end plate in place. The lug that is welded onto the bottom of the cellar has a ⅞-in. hole that fits over a ¾-in. stud in the keeper plate to hold the cellar in position in the box.

Details of an all-welded driving-box grease cellar

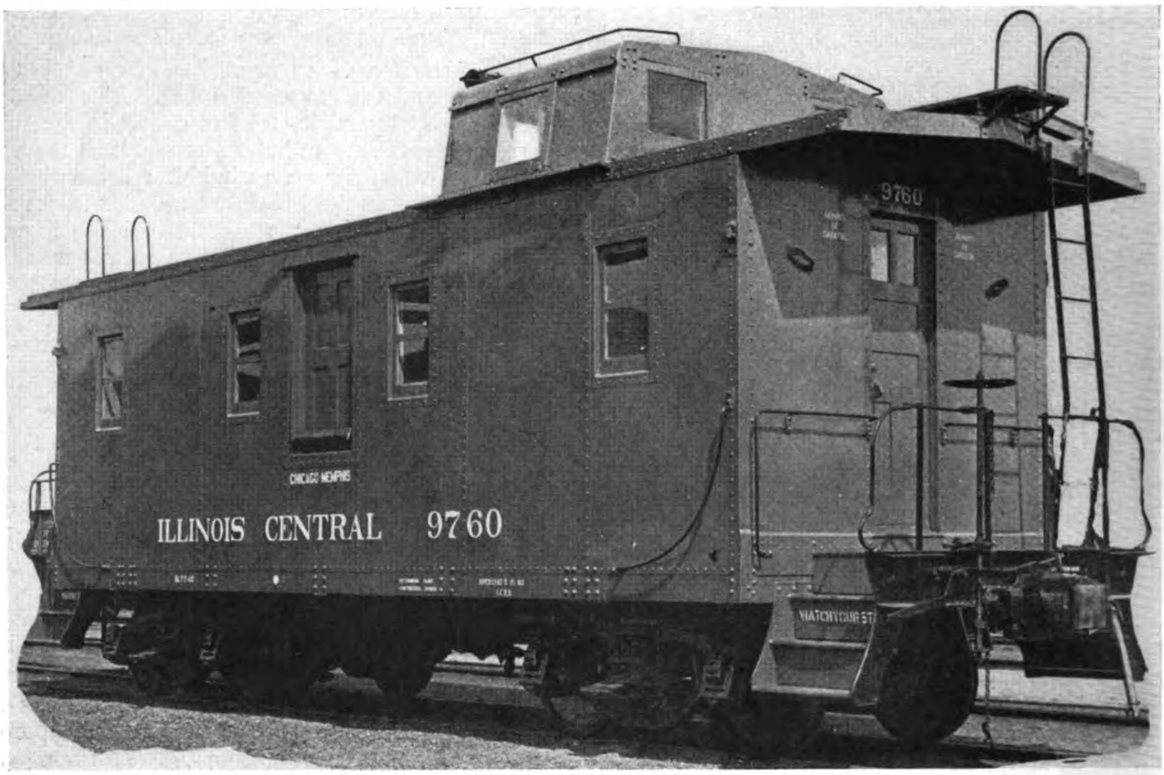




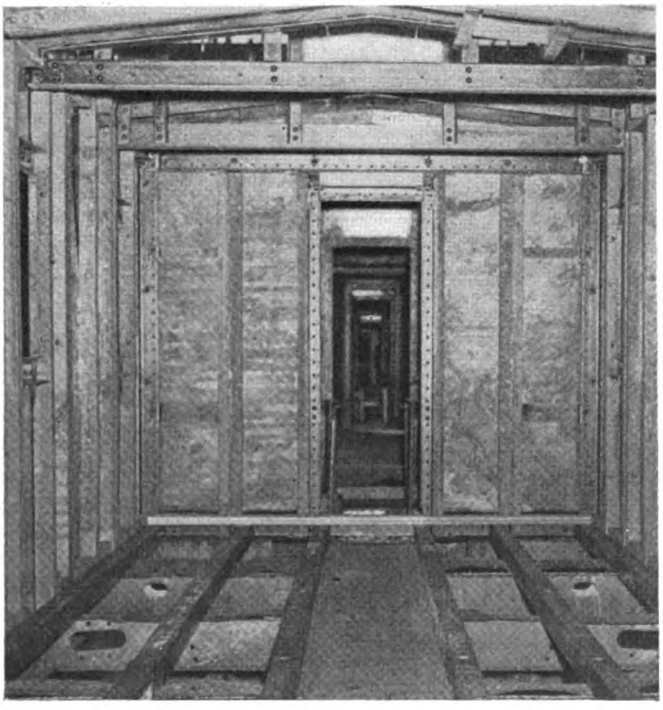
Illinois Central Builds 100 Steel Caboose Cars

The Illinois Central has recently completed the construction of 100 modern steel-sheathed caboose cars, built in the company shops, Centralia, Ill., from drawings and specifications drawn up by the railroad.

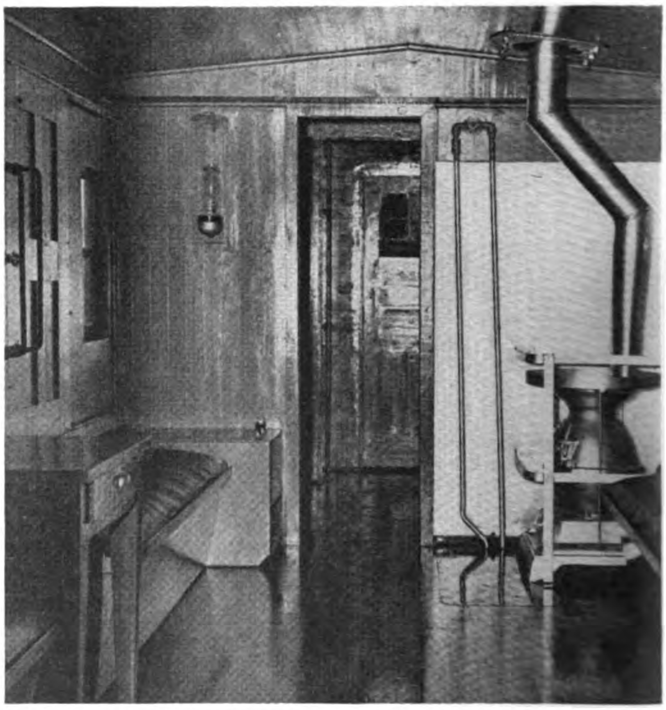
The steel underframes were constructed from reworked material, secured from a series of eight-door, drop-bottom gondolas which were retired from coal service some time ago, but showed little deterioration of the underframe parts. The superstructure, framing, sheathing and roof are copper-bearing steel, with combined riveted and welded framing members. The 14-gage roof sheets are applied transversely of the car, riveted to a vertical web of A-section side plates and edges butt-welded at the steel carlines. The roof sheets are of equal width with one exception, and roof carlines are so located as to provide two intermediate supports between roof



The completed steel-sheathed caboose



Interior of the steel car body before being insulated



Caboose interior ready for service

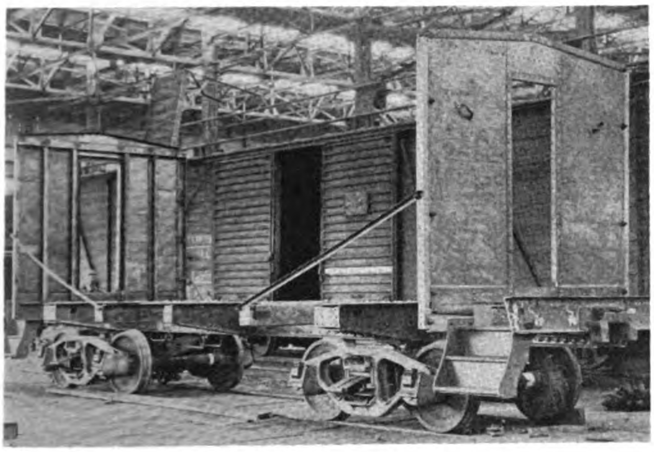
sheet joints, the roof sheets being spot-welded to these intermediate carlines.

The cupola framing and sheathing are a combined welded and riveted construction with cupola eaves rounded to present an improved appearance.

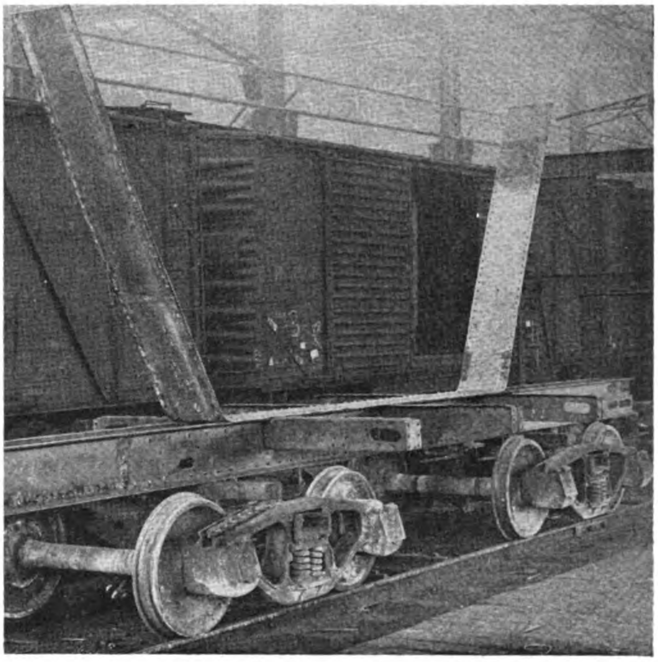
The inside surfaces of the side, end and roof sheets received one coat of rust preventative paint and one coat of plastic insulating and sound deadening material, applied 1/4 in. thick. A 1 1/2-in. layer of hairfelt insulation was then applied and secured in place by metal strips with self-tapping screws in framing members and wood screws in furring posts. The side and end walls and ceiling are lined with 13/16-in. by 5 1/4-in. tongue-and-groove long-leaf yellow pine.

The floor construction consists of a 1 3/4-in by 5 1/4-in. shiplap blind floor, laid transversely of the car and covered with a coat of car cement and layer of heavy waterproof paper. The 13/16-in. by 5 1/4-in. tongue-and-groove top flooring is laid lengthwise of the car. The platforms, steps and running boards are constructed of wood to the railroad's standard design.

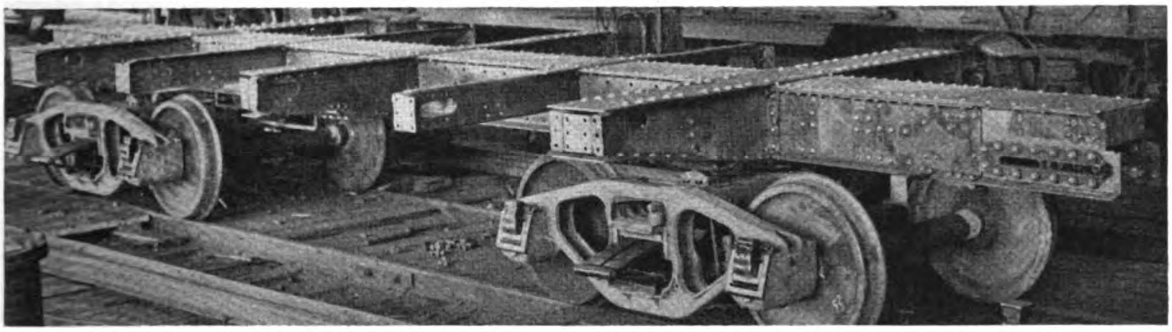
The interior fixtures include four bunks of steel construction, and the usual train crew accessories. Careful attention has been given to the safety feature in design-



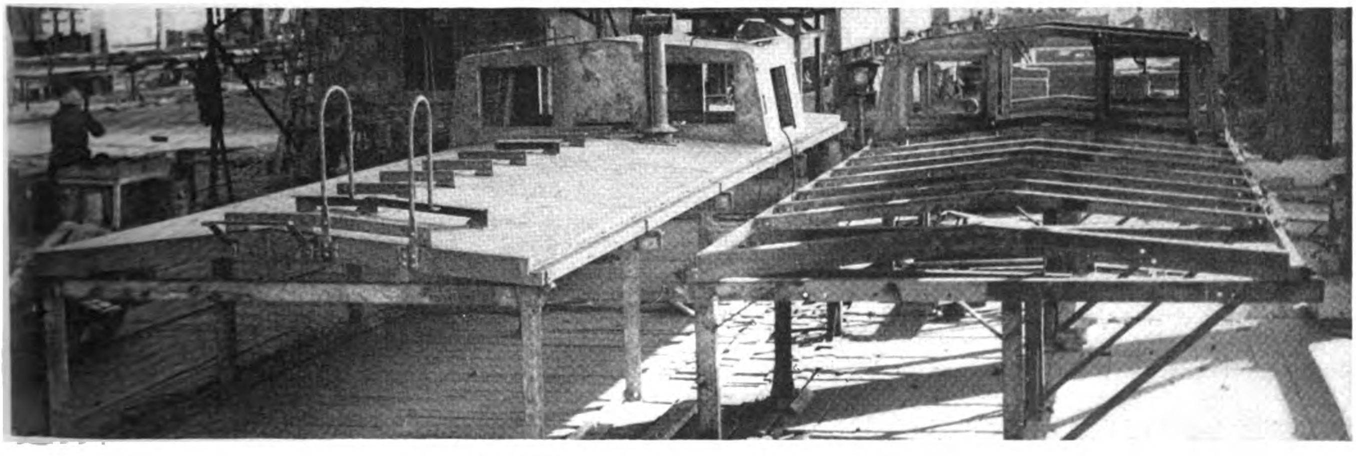
Application of steel ends to the caboose underframe



Original underframe in the process of shortening



The shortened underframe mounted on caboose trucks



Fabrication of the caboose roof and cupola

ing interior fixtures, sharp projections being avoided and corners rounded wherever possible.

The cars are mounted on re-worked Bettendorf trucks, to which elliptic springs have been applied, and wheels were ground after mounting.

The accompanying illustrations show the new Illinois Central cabooses in various stages of construction. The general dimensions of the car are as follows: Length over strikers, 34 ft. 1½ in.; length over body ends, 28 ft.; length inside, 27 ft. 3$\frac{3}{16}$ in.; length between truck centers, 19 ft.; length over roof, 33 ft. 1 in.; width over cupola side running boards, 10 ft. 5¼ in.; width over side posts, 9 ft. 7 in.; and average light weight of car, 49,000 lb.

The Car Inspector

*By Leonard West**

Having been a lead car inspector for several years, and as a result closely associated with his activities during this time, naturally I feel that the car inspector must be the subject of my paper tonight. In my opinion, he with his exacting duties, authority, responsibilities, etc., is one of the most essential of railway employees.

Let's for the moment, define some of his duties. (1) An inspection of inbound trains and cuts with the view of sifting out and correcting conditions which render cars, both loaded and empty, unsafe for main line movement; (2) preparation of outbound trains for departure, including inspection and test of air brakes, closing of side doors, examination of journal boxes and a running inspection to prevent some defect getting away that might have occurred in yard handling; (3) inspection of cars received in interchange, including issuing of defect cards covering unfair usage damage as shown in the interchange rules; this is very important, and involves thousands of dollars annually; (4) miscellaneous inspections, such as classifying empty cars for certain commodities, interior inspection of different kinds of freight, inspection of open top loads for safety and compliance with the Mechanical Division loading rules, servicing of industries and many others too numerous to mention.

I believe you will agree that all car department employees do not make good car inspectors. In this case, approval of the applicant by supervisors is important, and serious thought should be given to his schooling, penmanship, ability to learn, general attitude toward the work, etc., before he is assigned to these duties. In all cases a new man, in my opinion, should be given reasonable time to break in. Trying to teach him interchange and loading rules, safety rules, air brake operation, etc., in too short a time, only confuses him and results in retarding his progress. Periodical examinations, either oral or written, are helpful to all car inspectors in solving their daily problems. I also believe that too frequently the importance of the car inspector to the railroads is overlooked in the desire for rapid movement of cars through terminals. He must be given sufficient time to do his work if we expect to get the desired results.

One of the best assets a car inspector can have is the ability to use good judgment when called upon to do so. Shopping a load for some minor defect results in unnecessary switching and needless delay. Failure to notify yard men when cars have defective safety appliances, the use of which might result in injury, is also bad. In many cases cars are shopped for wheel defects which are run off repair tracks without repairs because some one either failed to, or did not properly use the wheel gage with which he was provided. These are only some examples where the car inspector can save his company money and we should work toward the elimination of all such cases.

The average car inspector is familiar with the weak points of system equipment and can tell from experience on which class car the sills, body and truck bolsters, side frames, or other parts may be failing. This information should be passed along to supervisors who should see that those interested in car construction learn of it.

To emphasize the authority of a car inspector, one has only to realize that he is just about the only man on a railroad who can stop the forward movement of a car. He does this simply by marking it "Bad Order." Then too, in a terminal like St. Louis he carries in his possession the check books of all the railroads entering the terminal. All he has to do is write a defect card covering certain delivering line defects and the company against whom the card is issued must pay for the cost of repairs. These two reasons alone, in my opinion, justify careful selection of men, for these positions and close cooperation between supervisors and inspectors thereafter.

April has been designated as Perfect Shipping and Careful Handling Month. The car inspector can and will play an important part in this. Close and careful inspection of cars for commodity loading will help. Removal of protruding nails and screws to prevent tearing of sacks and cartons is also an important item, in fact the many things that he can do in this campaign are too numerous for recording here.

* Lead car inspector, Missouri Pacific, St. Louis, Mo. This discussion by Mr. West of the duties of a car inspector, submitted at the April meeting of the Car Department Association of St. Louis, was awarded a prize as the third best paper presented by a car man below the rank of general foreman during the year 1940.

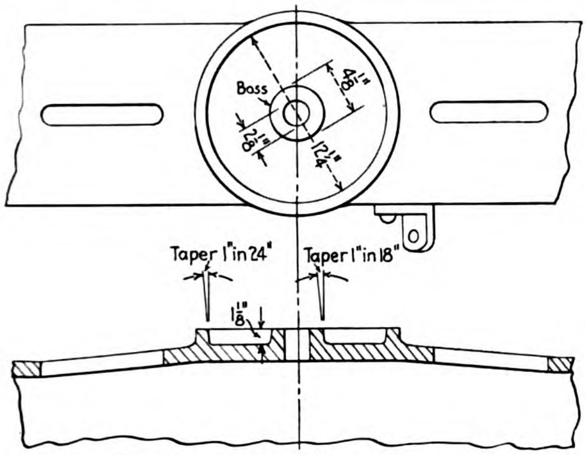
Re-Design of Center Plate Proposed

By W. C. Fox

Are center plates now in use a contributing factor in the derailments of freight cars? Would a new type of center plate which includes the center boss of the old style and the horizontal-bearing surface of the later type of plates, be an improvement? The boss in the center gives the proposed type, shown in the illustrations, a much smaller pivot point and reduces the friction between the vertical surfaces. It will be noted that the center boss takes all the horizontal friction. The outer vertical surfaces on the top and bottom center plates do not touch but they do act as a secondary defense. The center boss prevents the lubricant from being forced out through the king-pin hole in the bottom center plates as often happens with the present set-up when the car is lowered on the trucks. Vertical bearing surfaces would be changed to the inside and protected from dirt and grit and the loss of load-carrying bearing area in the bottom center plate would be very small.

It has been noted in repairing cars that the vertical

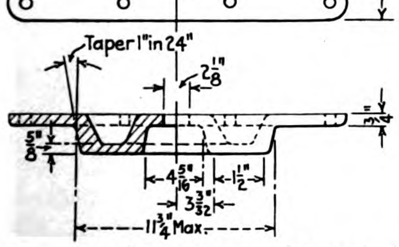
outside edge of the present top center plate, where it rubs on the vertical inside edge of the bottom center plate, shows scars where it has been cut and scored when the two faces rub together as the truck turns in taking a



Bolster center plate with re-designed boss

curve. The vertical flanges on the present bottom center plate act as a brake band on the edge of the top center plate; the larger the center plate, the greater the braking friction and the harder it is to swing the truck to follow the track curves.

The increased train resistance on a curve is caused by flange friction and wheel slippage. This additional resistance must be offset by increased drawbar pull at the engine; the engine trying to pull each car directly and in a straight line while the wheel flanges try to hold the car on the rails and make it take the indirect and longer route. The point of contact between the car body which is being pulled, and the wheels which guide the car, is the center plates. Therefore, the friction between the vertical portions of the upper and lower center plates must be very great in the front end or in the middle of a long train of cars on a curve. It is difficult for the wheels on the front cars to line up the truck with the straight track after the curve is passed, as the pull of the cars following is holding the vertical edges of the center



Changes in top center plate to accommodate re-designed bolster

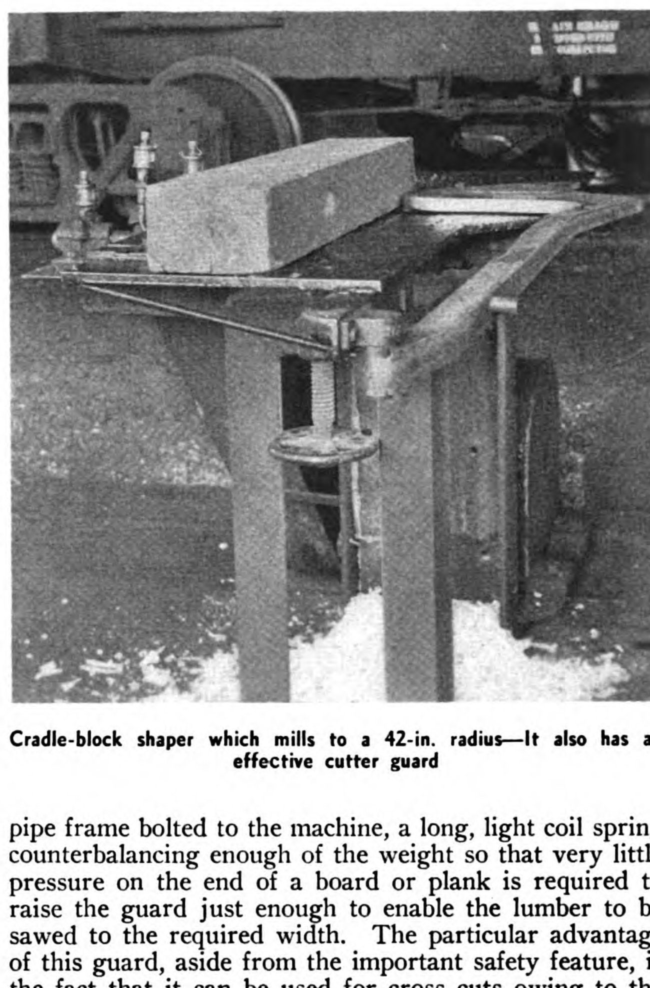
plates tight together on the inside of the curve. If the curve is on an ascending grade and the speed is slow, there will be no centrifugal force to throw the cars to the outside of the track and the flanges on the inside will take all the strain.

Two Woodworking Machine Guards

Two different types of woodworking-machine guards which are not especially new but possess a number of important advantages over the saw and cutter guards generally used in railway-shop mill rooms are shown in two illustrations.

The ripping cut-off saw guard shown in the first view is supplied by the Oliver Machine Company, St. Louis, Mo. It is applied to a saw table made locally. The saw is 22 in. in diameter, and is belt-driven from an electric motor of suitable size mounted in the base and operating on 440-volt, 25-cycle electric current. The saw is equipped with sight oil feed to the main bearings and a start-and-stop electric push button, located as shown in the upper part of the illustration. It is used primarily in sawing 6-in. by 8-in. cradle blocks.

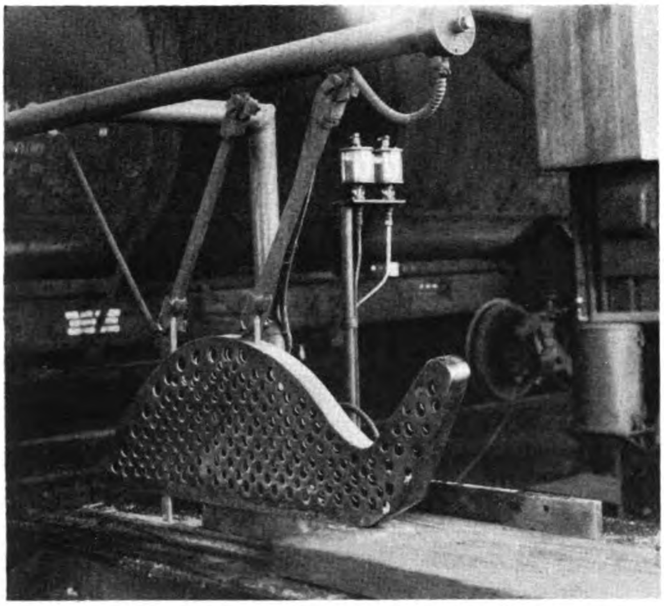
The perforated sheet-metal guard is supported by means of a pantagraph arrangement from an overhead



Cradle-block shaper which mills to a 42-in. radius—It also has an effective cutter guard

pipe frame bolted to the machine, a long, light coil spring counterbalancing enough of the weight so that very little pressure on the end of a board or plank is required to raise the guard just enough to enable the lumber to be sawed to the required width. The particular advantage of this guard, aside from the important safety feature, is the fact that it can be used for cross cuts owing to the method of suspension employed. The table also is capable of being tilted, which adds to the flexibility of this type of machine.

The cradle-block shaper, shown in the second illustration, is driven by a 2-hp. electric motor, also operating on 440-volt, 25-cycle current. The cutter knives are ground so as to machine the proper radius on cradle blocks for 8,000 and 10,000-gal. tanks. The machine is belt driven and a cutter adjustable to give the desired depth of cut. The horizontally swinging cutter guard, shown at the right in the illustration, normally covers the knives and moves off them under spring tension as the wood passes through, then immediately returning to



Shop-made ripping cut-off saw equipped with an unusually effective saw guard

the guard position. This method of milling cradle blocks quickly and accurately to the desired radius of about 42 in. is much more satisfactory than attempting to cut them out with any hand tools.

Air Brake Questions and Answers

D-22-A Passenger Control Valve (Continued)

642—*Q.—What brake-cylinder pressure is obtained from an emergency brake application from 110 lb. brake-pipe pressure with the A-4-A relay valve?* A.—Approximately 57 lb.

643—*Q.—What braking ratio will this brake-cylinder pressure develop?* A.—With the brake rigging arranged for 250 per cent braking ratio, the maximum braking ratio developed by the A-4-A relay valve from an emergency brake application is the same (150 per cent) as that developed by the Type B relay valve, or the universal valve.

644—*Q.—For what reason is 150 per cent braking ratio used with the D-22-A control valve equipment?* A.—In order to obtain harmonious brake operation when cars having control-valve brake equipment are associated with cars having the standard passenger-car equipment.

645—*Q.—What does a blow at the relay-valve exhaust port with the brake released indicate?* A.—A leak past the application valve of the relay valve.

646—*Q.—What does a blow at the relay valve with the brake applied indicate?* A.—A leak past the exhaust valve of the relay valve.

647—*Q.—How does leakage at the relay-valve exhaust affect the brake cylinder pressure?* A.—With the displacement reservoir and piping tight, brake cylinder pressure is automatically maintained against leakage by the operation of the relay valve self-lapping unit.

648—*Q.—Does variation in the brake-cylinder piston travel affect the amount of brake-cylinder pressure obtained from any given brake-pipe reduction?* A.—As the volume of the displacement reservoir does not vary and the brake-cylinder pressure is determined by the pressure in the displacement reservoir, variation of the brake-cylinder piston travel does not affect the brake-cylinder pressure development.

649—*Q.—What is indicated by leakage from the exhaust ports of the D-22-A control valve in release position?* A.—Leakage from the quick-service exhaust indicates leakage past the service graduating valve, service slide valve or service-portion cover gasket. Leakage from the displacement reservoir exhaust (pressure-retaining valve), indicates leakage past the service slide valve, release slide valve or service-portion body gasket. Leakage from the emergency portion exhaust indicates leakage past the vent valve, emergency slide valve, emergency graduating valve or emergency-portion body gasket.

650—*Q.—What is indicated by leakage from the exhaust ports of the D-22-A control valve in service lap position?* A.—Leakage from the quick-service exhaust indicates leakage past the service slide valve or service-portion cover gasket. Leakage from the displacement reservoir exhaust (pressure-retaining valve) indicates leakage past the release slide valve, service-portion body gasket or supply-valve charging checks *74* and *87*. Leakage from the emergency-portion exhaust indicates the same leakage as in release position.

651—*Q.—What is indicated by leakage from the exhaust ports of the D-22-A control valve in emergency position?* A.—Leakage from the quick-service exhaust indicates leakage past the service slide valve or service-portion cover gasket. Leakage from the displacement-reservoir exhaust (pressure retaining valve) indicates the same leakage as in the service lap position. Leakage from the emergency-portion exhaust indicates leakage past the emergency slide valve, emergency-valve seal or emergency-portion body gasket.

652—*Q.—What should be done if leakage is experienced with the control valve equipment?* A.—If leakage is excessive or interferes with the normal operation of the equipment, proper report should be made which will insure correct repairs or replacement of defective portions with those known to be in good order.

653—*Q.—Does leakage at the exhaust ports of the control valve justify attempt to make repairs at the car to which the valve is attached.* A.—The exact location of the leakage can only be determined by prescribed test on an approved test rack. In any event, to dismantle a valve on the car is not permissible because of possible damage due to dirt or improper handling of parts.

654—*Q.—When attaching an uncharged car having D-22-A control valve equipment to a train, how much time should be allowed for charging before a brake test is made?* A.—Approximately 10 minutes.

655—*Q.—After an emergency brake application, how much time should be allowed before attempt is made to release?* A.—Approximately 20 seconds.

656—*Q.—Why is it necessary to wait this time?* A.—Because the vent valve on each control valve remains open approximately 20 seconds, making large direct openings from the brake pipe to the atmosphere, therefore, the brake-pipe pressure can not be restored to release the brakes in less than the time required for the vent valve to close.

* * *

Photo by C. F. H. Allen

D. L. & W. locomotive No. 1628 going up grade at Danville, N. Y.

(*Turn to next left-hand page*)

High Spots in
Railway Affairs . . .

Beating the Blitzkrieg

Press advertisements and posters of the British railways tell something of the spirit in which the railways and the public are co-operating to meet the wartime emergencies. One advertisement, under the caption, "What Station Is This," includes the following statement. "Station names are now in small letters. If you can't see the name and can't hear the porter's voice, ask another traveler. It is dangerous to raise the blind and to make the train a target for bombers. If you know where you are by local signs and sounds, please tell others in your carriage. We will beat the blitzkrieg by helping one another."

Traffic for The First Quarter

According to estimates made by the thirteen Shippers Advisory Boards, freight car loadings in the first quarter of 1941 are expected to exceed those for the same period last year by 9.5 per cent. As is to be expected, because of the war conditions abroad and our own national defense program, the heavy goods industries will make the largest contribution to this increased traffic. Those commodities which are expected to show the greatest increases are iron and steel, 34.9 per cent; brick and clay products, 30 per cent; machinery and boilers, 27.9 per cent; gravel, sand and stone, 22.9 per cent; lumber and forest products, 19.8 per cent; ore and concentrates, 16.4 per cent; chemicals and explosives, 16.2 per cent; and automobiles, trucks and parts, 15.7 per cent.

Competition for Passenger Traffic

The great bulk of the inter-city passenger traffic by public and private carriers is handled on the highways, and largely by private automobiles. The Interstate Commerce Commission, in its recent report, estimates that during the calendar year of 1939 private automobiles accounted for 85.44 per cent of the inter-city traffic on a passenger-mile basis. The railways handled only 8.62 per cent, buses 5.15 per cent, water carriers 0.54 per cent and the air carriers 0.25 per cent. The picture changes radically if private automobiles are excluded and only commercial carriers are considered. On that basis the railroads in 1939 handled 59.17 per cent of the commercial passenger-miles, the buses 35.42 per cent, inland waterways 3.71 per cent and airways 1.70 per cent. The report also points out that "travel by air is competitive with sleeping and parlor car service by rail and hence it is significant that the ratio of revenue passenger-miles by air to passenger-miles in sleeping and parlor cars was 6.5 per cent for 1938, 9.0 per cent for 1939, and 12.7 per cent for the first half of 1940."

St. Lawrence Seaway Crops Up Again

President Roosevelt, on the plea of national defense, has again dragged out the St. Lawrence Seaway project. The fallacy of this argument was clearly exposed by Judge R. V. Fletcher, general counsel, Association of American Railroads, at a meeting of the Atlantic States Shippers Advisory Board in New York, on January 9. He pointed out that since the navigation channel cannot be completed in less than eight years from the time the actual construction begins, it will be of no service in the present war emergency. He also said that the 27-ft. channel contemplated would bar from passage, when fully loaded, 54 per cent of the world's vessels, representing 70 per cent of its tonnage and including all war vessels of capital proportions. Moreover, the seaway cannot be used for more than seven months of the year because of ice, and 16 days would be required to make the round trip from Montreal, Que., to Duluth, Minn. With long range aerial fighters and bombers, a shipyard located at Cleveland would hardly be more immune from attack than one located at Chester, Pa. Speaking of sabotage he pointed out that one bomb from the air, or one charge of dynamite placed by a fifth columnist, might put the canal out of business indefinitely. Finally, he declared that "very competent authorities reach the conclusion that the total costs will reach the sum of $1,200,000,000, a huge sum of money subtracted from amounts which would otherwise be available for national defense."

I.C.C. and National Defense

In discussing transportation and national defense in its fifty-fourth annual report, the Interstate Commerce Commission says, "There has been considerable debate as to whether the railroads are taking adequate steps to expand their supply of cars and locomotives to meet the needs which may be expected." It points out that because of the sharp decline of traffic during the past decade, the number of freight cars retired by Class I railroads every year, from 1929 to 1939, exceeded the additions. This has caused concern in some quarters, but the Commission points out "that the railroads are now able, because of improved methods and conditions of operation, to do materially more work per unit of equipment than was the case when they had a greater supply." It points out also that the capacity of other forms of transportation has greatly increased. While the Commission believes that the question is a serious one and of vital importance in the defense program, it realizes that Ralph Budd, a member of the Advisory Commission of the Council of National Defense and president of the Chicago, Burlington & Quincy, and his consultants recognize the imporance of the problem and "are considering it from every angle. They have the means," says the Commission report, "which are much better than any that we have at our command, of appraising the transportation needs which are likely to arise and also the facilities which are available or should be available to meet those needs."

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Railroad's Share Of Freight Traffic

In its recent annual report the Interstate Commerce Commission attempted to compare the relative importance of different types of carriers. It admits that this comparison involved "broad estimates which may be subject to a considerable margin of error." It was impractical to attempt to make estimates for 1940, and so the figures show a comparison between the years 1938 and 1939. On the basis of estimated ton-miles, all of the types of transportation showed a considerable increase. Total ton-mileage in 1939 was estimated as 543,375 millions, as compared to 460,689 millions in 1938, or roughly, an increase of about 18 per cent. In the distribution of the increased traffic, however, the highway carriers and the inland waterways made a somewhat better showing on a percentage basis than did the railways and the pipe lines. On a ton-mileage basis the railroads had 61.85 per cent of the total traffic in 1939, as compared to 63.49 per cent in 1938. The inland waterways, including the Great Lakes, had 17.71 per cent in 1939, compared to 14.49 per cent in 1938. The pipe lines' percentage of the total decreased from 13.99 in 1938 to 11.97 in 1939. On the other hand, the highway traffic increased from 8.03 in 1938 to 8.47 in 1939. The ton-miles of air mail and express was less than .01 per cent of the total. The improved position of the inland waterways was due largely to the iron ore traffic on the Great Lakes.

NEWS

Mile-A-Minute Runs—63,447 Miles of Them

SEPARATE passenger runs in the United States and Canada operating daily at an average speed of a mile-a-minute or more grew during 1940 from 997 to 1,226—a jump of 23 per cent—according to an annual train schedule survey recently completed and made public by "Railroad Magazine." The total mileage covered by these fast trains also increased from 54,956 to 63,447, or 15½ per cent. By including the records of trans-continental streamliners that operate only on certain days, the current figures total 1,294 runs and 73,165 miles as compared with 1,070 runs and 65,034 miles at the end of 1939.

The extension of mile-a-minute railroading, it is pointed out, is primarily due to the general improvement of inter-city services rather than to a spectacular speed-up on any one system. Since the first of 1940, the tabulation discloses, 11 runs were added to those listed at speeds of 70 m. p. h. and more, bringing the total number to 96. These fast trains cover an aggregate distance of 7,387 miles, all but 2,156 of which are booked daily.

Railroad Magazine's first survey of North American passenger train schedules was conducted in 1936, when there were 579 separate daily runs at an average speed of 60 m. p. h. and better, with a combined mileage of 29,301. This indicates that the mile-a-minute performances of American and Canadian passenger trains have more than doubled in four years.

Locomotive and Car Supply Adequate Pelley Believes

"RAILROADS of the United States enter 1941 with a plant that is geared to meet any transportation demand that may be made of them," said J. J. Pelley, president of the Association of American Railroads in a year-end statement summarizing the performance of the railroads in 1940. He added that "not only is car and motive power supply adequate on the basis of traffic now anticipated, but the railroads are being operated at new high efficiency levels"; and "at the same time new equipment is being added as traffic demands or replacements of obsolete equipment may require."

Mr. Pelley's statement continued as follows:

"In the current year the railroads installed in service 65,000 new freight cars and 400 locomotives and have 30,000 freight cars and 180 locomotives under construction. Since June 1, 1939, the number of freight cars in need of repairs has been cut in half. As a result, the number of freight cars in need of repair is now less than it has been at any time back to 1920.

"Based on conservative estimates, which take into consideration new freight cars actually put in service or under construction as well as those undergoing heavy repairs, the railroads will have at least 160,000 more freight cars available this coming fall than they had two years ago. Car-buying, however, is a continuing program and unquestionably there will be a still further increase in such cars by next October. On the basis of utilization obtained from freight equipment in the past, those 160,000 cars will handle 100,000 carloads per week, or 5,200,000 carloads per year, which is equivalent to one-seventh of the total number of carloadings handled in 1940.

"From the standpoint of operating efficiency, railroad performance was never better than in 1940.

"Railroads in 1940 hauled an average of 850 tons of freight per train, the highest on record and an increase of approximately 30 per cent compared with 1921. The average number of freight cars per train has increased from 37.4 cars in 1921 to 49.7 cars in 1940, or 33 per cent. Performance per train has doubled within that period. That is, the gross ton-miles per train hour increased from 16,555 in 1921, to 33,856 in 1940 while the net ton-miles per freight train hour increased from 7,506 in 1921 to 14,060 in 1940. In both instances, these are new high records. For each pound of fuel used in freight service in 1940 the railroads hauled nine tons of freight and equipment one mile compared with 6⅘ tons in 1921.

"Railroads enter 1941 with a level in freight traffic approximately seven per cent above one year ago. While it is still too early to forecast very definitely the trend of traffic in the coming year, the present expectation is that it will run from seven to ten per cent above 1940. Loading of revenue freight in 1940 totaled 36,350,000 carloads, an increase of 2,500,000 or 7.2 per cent above 1939 and nearly 6,000,000 or 19.3 per cent above 1938, but a decrease of 9,500,000 or 20.8 per cent below 1930. On the basis of revenue ton-miles (the number of tons of revenue freight multiplied by the distance carried) freight traffic in 1940 amounted to 370 billion, an increase of 11 per cent above 1939.

"Passenger travel in the past 12 months amounted to 23,700,000,000 passenger miles (the number of passengers multiplied by the distance traveled), an increase of 4.6 per cent compared with 1939 and an increase of 9.6 per cent compared with 1938. Passenger rates were lower in 1940 than in any preceding year, the average revenue per passenger mile having been 1.75 cents compared with 1.84 cents in 1939.

"While complete reports are not available, the Class I railroads in 1940 are expected to have a net railway operating income before fixed charges of $650,000,000, or a return of 2.49 per cent on their property investment. . . . After fixed charges the Class I railroads, according to estimates, will have a net income in 1940 of $155,000,000 compared with $93,000,000 in 1939.

"Maintenance expenditures of Class I railroads in 1940 totaled $1,317,000,000 compared with $1,233,000,000 in 1939. Of the total of 1940, expenditures for maintenance of equipment amounted to $817,000,000 and for maintenance of way and structures, the amount was $500,000,000.

"Expenditures for fuel, supplies and materials used in current operation by the Class I railroads amounted to approximately $850,000,000 in 1940 compared with $769,000,000 in 1939, and $583,000,000 in 1938.

"Capital expenditures in 1940 for equipment, roadway and structures and other improvements to property are estimated at $400,000,000, compared with $262,000,000 in the preceding year. This can be contrasted with $794,000,000, the average annual capital expenditure from 1927 to 1930.

"The increase in traffic as well as large expenditures for maintenance work resulted in a further increase in employment on the railroads in the past year, the average number of employees having been 1,026,000, or an increase of 3.9 per cent compared with the preceding year. Average annual earnings per employee in 1940 was $1,900 compared with $1,886 in 1939.

Orders and Inquiries for New Equipment Placed Since the Closing of the January Issue

LOCOMOTIVE ORDERS

Road	No. of Locos.	Type of Locos.	Builder
American Steel & Wire Co.	1	660-hp. Diesel-elec.	American Loco. Co.
	1	660-hp. Diesel-elec.	Baldwin Loco. Wks.
Atchison, Topeka & Santa Fe	1	360-hp. Diesel-elec.	Davenport Besler Corp.
	1	360-hp. Diesel-elec.	Whitcomb Loco. Wks.
Birmingham Southern	1	1,000-hp. Diesel-elec.	American Loco. Co.
Canadian Car & Munitions, Ltd.	2	300-hp. Diesel-elec.	General Electric Co.
Central of Georgia	2	600-hp. Diesel-elec.	Electro-Motive Corp.
	1	1,000-hp. Diesel-elec.	
	1	1,000-hp. Diesel-elec.	American Loco. Co.
	1	660-hp. Diesel-elec.	
Charles City Western	1	150-hp. Diesel-elec.	General Elec. Co.
Inland Steel Co.	1	600-hp. Diesel-elec.	Electro-Motive Corp.
	1	660-hp. Diesel-elec.	American Loco. Co.
Lone Star Cement Corp.	1	175-hp. Diesel-elec.	Vulcan Iron Works
Messena Terminal	1	660-hp. Diesel-elec.	American Loco. Co.
Newburgh & South Shore	2	660-hp. Diesel-elec.	American Loco. Co.
New York Central	1	600-hp. Diesel-elec.	Baldwin Loco. Wks.
	26	600-hp. Diesel-elec.	Electro-Motive Corp.
	9	660-hp. Diesel-elec.	American Loco. Co.

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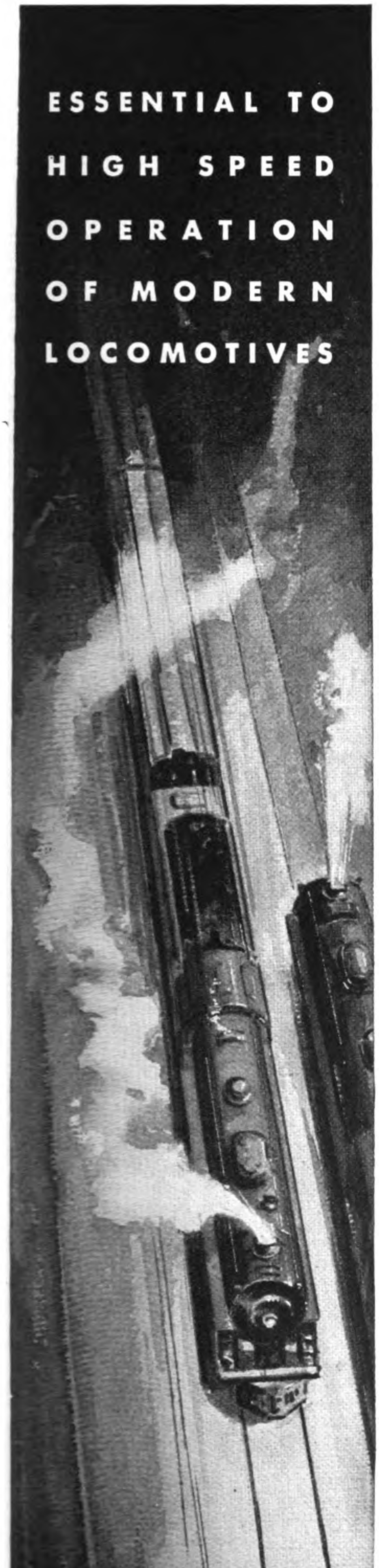

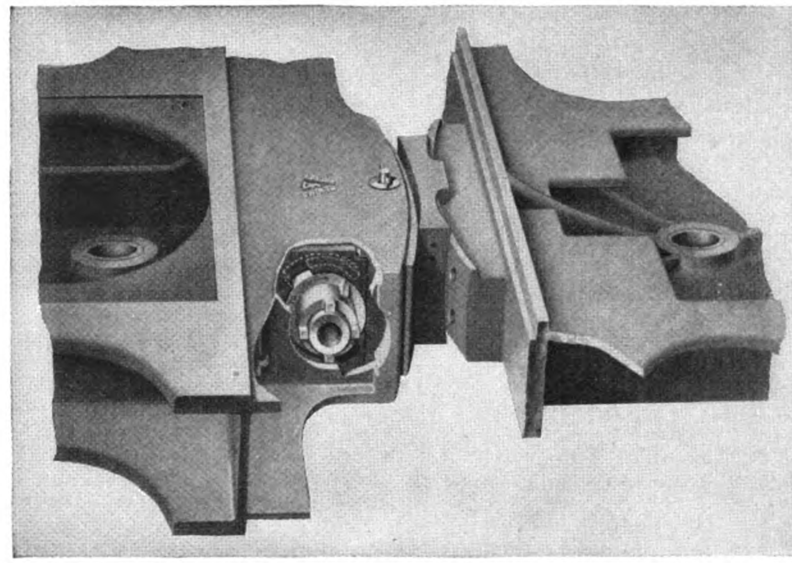

Modern power, with long overhang over the trailing truck, must have freedom of buffer movement in every direction, and full faced contact of the buffer surfaces at all times.

It is absolutely necessary on curved track, and safer at high speeds.

Franklin E-2 Radial Buffer provides this universal movement and full contact of the buffer surfaces. It also provides high frictional resistance to compression that effectively dampens oscillation between engine and tender and eliminates lost motion and subsequent destructive shocks to drawbars and pins.

Franklin E-2 Radial Buffer effectively reduces locomotive maintenance costs and adds immeasurably to the safety of high speed operation of modern locomotives.

Franklin Compensator and Snubber, twin of the Radial Buffer, is equally essential for that other important job of protecting the foundation of the locomotive.

No locomotive device is better than the replacement part used for maintenance.
Genuine Franklin repair parts assure accuracy of fit and reliability of performance.

FRANKLIN RAILWAY SUPPLY COMPANY, INC.

NEW YORK **CHICAGO** **MONTREAL**

Patapsco & Black Rivers	2	1,000-hp. Diesel-elec.	Baldwin Loco. Wks.
Pennsylvania	20[1]	21,000-gal. loco. tenders	Company shops
Philadelphia, Bethlehem & New England	2	600-hp. Diesel-elec.	Electro-Motive Corp.
River Terminal	1	660-hp. Diesel-elec.	American Loco. Co.
Sanderson & Porter Co.	2	300-hp. Diesel-elec.	General Electric Co.
Sao Paulo-Parana R. R. of Brazil	1	2-8-2	Baldwin Loco. Wks.
Seaboard Air Line	1	660-hp. Diesel-elec.	American Loco. Co.
	1	660-hp. Diesel-elec.	Baldwin Loco. Wks.
South Buffalo	3	660-hp. Diesel-elec.	American Loco. Co.
Texas Pacific-Missouri Pacific Terminal	1	660-hp. Diesel-elec.	American Loco. Co.
Union Pacific	15	4-8-8-4	American Loco. Co.
	10	1,000-hp. Diesel-elec.	Electro-Motive Corp.
United Fruit Co.	4[2]	2-8-2	Baldwin Loco. Wks.
Youngstown & Northern	1	1,000-hp. Diesel-elec.	American Loco. Co.

LOCOMOTIVE INQUIRIES

Denver & Rio Grande Western	5-10	4-6-6-4	
Missouri Pacific	2[3]	1,000-hp. Diesel-elec.	
	5[3]	600-hp. Diesel-elec.	
	11[3]	44-ton Diesel-elec.	
New York, New Haven & Hartford	10	600-hp. Diesel-elec.	

FREIGHT-CAR ORDERS

Road	No. of Cars	Type of Cars	Builder
Western Rwy. of Alabama			
Chicago, Burlington & Quincy	250	70-ton ballast	American Car & Fdry. Co.
Carnegie-Illinois Steel Co.	8	100-ton flat	Pressed Steel Car Co.
	1	Flat	Greenville Steel Car Co.
Duluth, Missabe & Iron Range	100	50-ton gondola	American Car & Fdry. Co.
Elgin, Joliet & Eastern	250	Hopper	Ralston Steel Car Co.
	350	Gondola	Gen. Amer. Transp. Corp.
	150	Gondola	Mt. Vernon Car Mfg. Co.
	200	Box	
	300	Box	American Car & Fdry. Co.
Illinois Central	115	70-ton gondola	Gen. Amer. Transp. Corp.
Litchfield & Madison	50	50-ton hopper	American Car & Fdry. Co.
	50	50-ton hopper	Gen. Amer. Transp. Corp.
New York Central	1,000[4]	55-ton box	Pressed Steel Car Co.
Northern Pacific	1,000	50-ton box	American Car & Fdry. Co.
	300	50-ton hopper	
	200	70-ton ballast	
	900	50-ton box	Pull.-Std. Car Mfg. Co.
	100	50-ton box	Company shops
Pennsylvania	2,000[1]	50-ton box	Company shops
	2,500[1]	70-ton gondola	
	600[1]	Bulk container	
	200	Cabooses	
Pennsylvania Salt Mfg. Co.	6	Tank	American Car & Fdry. Co.
	2	Tank	
Russian Government	100	Air-dump	Pressed Steel Car Co.
Union Pacific	250	50-ton auto-box	Company shops
	2,000	50-ton box	
Utah Copper Co.	100	100-ton ore	Pressed Steel Car Co.
	15	Air-dump	
Wabash	5	70-ton hopper	American Car & Fdry. Co.
Warren Petroleum Co.	30[2]	11,000-gal. tank	American Car & Fdry. Co.
	10[2]	10,500-gal. tank	

FREIGHT-CAR INQUIRIES

Chicago & North Western	1,000	Gondolas	
	200	Ore	
	500	Box	
Lake Superior & Ishpeming	100	50-ton ore	
Missouri Pacific[3]	1,200	55-ton hopper	
	100	50-ton auto box	
	2	Well-type	
	70	70-ton cement	
	2	Depressed center flat	
South African Rwys. & Harbors	1,000	Gondola	
Tennessee Coal, Iron & R. R. Co.	90	70-ton ore	
	20	70-ton flat	
	6	70-ton slab side hot hole	
Union Pacific	300	Flat	
	50	Mill-type gondola	
Virginian	100	50-ton hopper	

PASSENGER-CAR ORDERS

Road	No. of Cars	Type of Cars	Builder
Atlanta & West Point	2[2]	Baggage-express	American Car & Fdry. Co.
New York Central	45[5]	Coaches	Pull.-Std. Car Mfg. Co.
	25[5]	Coaches	American Car & Fdry. Co.
	25[5]	Coaches	Pressed Steel Car Co.

PASSENGER-CAR INQUIRIES

Missouri Pacific	1[3]	Rail-motor	
	2[3]	Trains	

[1] Orders let to the shops of the Pennsylvania for the locomotive tenders and freight cars reported here, for the remodeling and air conditioning of 80 passenger coaches, and for the purchase of five electric passenger locomotives, total $17,500,000.

[2] Delivery received.

[3] Permission received from the district court to secure competitive bids for this equipment. The locomotives, freight cars, and rail motor car will be for use on the Missouri Pacific and its subsidiaries. Each of the two streamline trains will consist of a 4,000-hp. Diesel-electric locomotive, a combination mail and baggage car, two coaches, a combination diner and lounge car, a baggage-express car, and a mail storage car.

[4] For service on the Pittsburgh & Lake Erie.

[5] The 95 coaches, to cost approximately $5,000,000, will be air conditioned, of all-steel construction, 80 ft. 6 in. in length, and will seat 56 passengers. They will have adjustable reclining chairs, brilliant lighting and unusually large washrooms. Deliveries are expected to begin about June.

I. C. Rail Cars—A Correction

THE buffet equipment on the new Illinois Central rail motor cars operating between Chicago and Champaign, Ill., and between Jackson, Miss., and New Orleans, La., respectively, was furnished by The Stearnes Co., Chicago, and not by Angelo Colonna as stated on page 12 of the January *Railway Mechanical Engineer.*

Equipment Purchasing and Modernization Programs

The Baltimore & Ohio has awarded a contract to the George F. Hazlewood Company, Cumberland, Md., for the construction of an extension to the company's enginehouse at Cumberland, Md., at an estimated cost of $50,000.

The Chicago & North Western is considering the purchase of a Diesel-electric, lightweight streamlined train for operation between Chicago and Green Bay, Wis., a distance of 199.7 miles.

The Norfolk Southern has asked the Interstate Commerce Commission to approve a plan whereby it would issue and sell to the Reconstruction Finance Corporation $938,000 of its three per cent serial equipment trust certificates maturing in 30 semiannual installments beginning August 1, 1941, and maturing in the amount of $32,000 on that date, and $32,000 on each February 1 and August 1, thereafter to and including February 1, 1945, and $31,000 on August 1, 1945, and $31,000 on each February 1 and August 1 thereafter to and including February 1, 1956. The proceeds will be used as part payment for new equipment costing $946,000 and consisting of 250 40-ton A. A. R. 4-C-40, steel-sheathed, wood-lined box cars; 50 50-ton all-steel gondola cars, and 50 50-ton hopper coal cars. Orders for this equipment were announced in the January issue.

The Seaboard Air Line has asked the Interstate Commerce Commission to approve a plan whereby it would issue and sell to the Reconstruction Finance Corporation $1,905,000 of three per cent serial equipment trust certificates, maturing in 15 equal annual installments beginning January 1, 1942. The proceeds will be used as part payment for new equipment costing a total of $2,159,700 and consisting of two 660-h.p. Diesel-electric switching locomotives, 500 new 50-ton, all-steel, double sheathed box cars, with wood lining, and 200 new 70-ton all-steel hopper cars.

The Union Pacific has asked the Interstate Commerce Commission for authority to assume liability for $12,570,000 of 1½ per cent equipment trust certificates, maturing in equal annual installments of $838,000 on January 1 in each of the years from 1942 to 1956, inclusive. The proceeds will be used as part payment for new equipment costing a total of $15,712,500 and consisting of 2,000 lightweight steel box cars with wood lining, 250 50-ft. automobile cars, 1,000 steel ballast cars, 15 4-8-8-4 type locomotives with tenders, 300 52-ft. 8½-in. flat cars, and 50 65-ft. low-side, mill type gondola cars. The company's petition states that the 2,000 box cars and the 250 automobile cars will be constructed in its own shops. Orders for the 15 locomotives and some of the freight equipment are announced in this issue.

(*Turn to next left-hand page*)

Supply Trade Notes

BRUCE M. JONES has been appointed sales engineer of the Buffalo Brake Beam Company with headquarters in New York.

◆

ALEX S. ANDERSON has been appointed district manager for the midwestern territory of the Duff-Norton Manufacturing Company, with headquarters at Chicago.

◆

GEORGE L. COTTER has been appointed commercial engineer of the Westinghouse Air Brake Company, with headquarters at the general office in Wilmerding, Pa.

◆

ERNEST A. FLINN has been appointed sales representative of the Gustin-Bacon Manufacturing Company, Kansas City, Mo., with headquarters at New York.

◆

COOPER-BESSEMER CORP.—*C. B. Jahnke,* formerly vice-president and general manager of the Cooper-Bessemer Corporation has been elected president to succeed *B. B. Williams,* who has become chairman of the board. *E. J. Fithian,* former chairman, has resigned but will continue as a director.

◆

JOHN L. HOFFMAN has been appointed sales representative for The Oxweld Railroad Service Company in Southeastern territory, succeeding W. M. Leighton, retired. Mr. Hoffman has been actively engaged in the promotion of oxy-acetylene welding and cutting for twenty-two years. He started in business with Taylor-Wharton Iron &

John L. Hoffman

Steel Co., later joining the Central of New Jersey at its Elizabethport (N. J.) shops, working on welding projects in connection with locomotives. In 1922 he took a position as welding instructor with The Oxweld Railroad Service Company, Mechanical department, and worked for this company on a number of railroads in New England. Mr. Hoffman was made district superintendent for the New England territory in 1926 and had under his charge the mechanical and maintenance-of-way department's welding activities and instructors. Since 1936 he has been assistant general superintendent, with headquarters in Chicago.

M. C. BELLAMY, sales engineer for the Timken Roller Bearing Company at Seattle, Wash., has been promoted to district manager of industrial bearing and steel sales for the Seattle territory. Mr. Bellamy graduated from Purdue University and spent several years in other industrial work before joining The Timken Roller Bearing Company in 1928. After working in the plant and engineering department for two years, he was appointed sales engineer in 1930.

◆

ROBERT E. FRAME, sales manager of the Standard Car Truck Company, Chicago, has been elected vice-president. Mr. Frame was born in Chicago on August 28, 1877, and received his education in the public schools of Chicago. He enlisted in the United States Army during the Spanish War and in 1900 entered the employ of

Robert E. Frame

the Pullman Company. He resigned as freight-car estimator in September, 1904, to accept a similar position with the American Car and Foundry Company at St. Louis, Mo. By 1909 he had progressed to the position of mechanical superintendent, with supervision over the drafting and estimating departments. He was then promoted to sales engineer at Chicago. In 1912 he resigned to become assistant to the president of the Haskell & Barker Car Company, Michigan City, Ind. Mr. Frame resigned from the Pullman Car and Manufacturing Company (successors to Haskell & Barker Car Company), in September, 1923, to enter the brake-shoe business as one of the founders of the Central Brake Shoe & Foundry Company. Six years later this company was absorbed by the American Brake Shoe & Foundry Company and Mr. Frame became associated with the Standard Car Truck Company. In 1934 he was appointed sales manager.

◆

GRIP NUT COMPANY.—The sales and general offices of the Grip Nut Company have been moved from South Whitley, Ind., to 310 S. Michigan avenue, Chicago, at which address the company has maintained an executive office for a number of years.

C. N. THULIN, vice-president of the Duff-Norton Manufacturing Company, with headquarters at Chicago, has resigned to become manager of railway sales of the Joyce-Cridland Company, Dayton, Ohio.

Mr. Thulin entered railway service with the Northern Pacific in 1886 and resigned in 1902 to enter the supply business in St. Paul, Minn. He was employed by the Chicago Pneumatic Tool Company for a number of years and in 1910 became western sales manager of the Duff Manufacturing Company. Later he was elected vice-president of the successor company, the Duff-Norton Manufacturing Company.

◆

GRIP NUT COMPANY.—*Chester D. Tripp* has been elected president of the Grip Nut Company, Chicago, to succeed *John H. Sharp,* resigned. *Ernest H. Weigman,* of the sales department, has been appointed sales manager. Mr. Tripp has been a member of the board of directors for twenty years. He is an industrial engineer and is associated with a number of other companies either as a director or officer. He has been active in the last two decades in the iron and steel industry, in mining and metallurgy, and in general industrial enterprises.

Ernest H. Weigman, who has been appointed sales manager, was born in De Soto, Mo., on July 29, 1892, and entered

Ernest H. Weigman

railway service in 1909 as a car repairer and inspector on the Louisville & Nashville. From 1910 to 1917 he served as a piecework checker of the Missouri Pacific at St. Louis, Mo., a traveling car inspector of the Great Northern and the Northern Pacific at St. Paul, a traveling instructor for the Atlantic Coast Line, and assistant secretary of the American Railway Master Mechanics' Association and of the Master Car Builders' Association. In August, 1917, he became supervisor of car repairs for the Louisville & Nashville, at Louisville, Ky., and in October, 1925, was appointed master car builder of the Kansas City Southern at Pittsburg, Kan. He resigned from that position on September 1, 1930, to enter the sales department of the Grip Nut Company.

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Vapor Car Heating Company.—*James T. Clark,* who has been in charge of sales in the northern territory of the Vapor Car Heating Company, Inc., Chicago, with headquarters at St. Paul, Minn., has been promoted to assistant sales manager, with headquarters at Chicago, and has been succeeded by *Franklin E. Hess,* sales engineer at Chicago. Mr. Clark was born in Dubuque, Iowa, in 1896. In 1912 he entered the employ of the Chicago, Milwaukee, St. Paul & Pacific, and was successively clerk in the car department, car foreman and general car foreman at various points on the road. In 1925, he entered the sales department of the Vapor Company at St. Paul, where he has been in charge of sales in the northwest territory.

◆

American Locomotive Company. — *Joseph B. Ennis* has been appointed senior vice-president of the American Locomotive Company, and *James E. Davenport* has been appointed vice-president of engineering, development and research. *William A. Callison,* assistant district sales manager at Chicago, has been appointed district sales manager to succeed *William S. Morris,* who was elected vice-president of the Montreal Locomotive Works, Montreal, Que., last June. *Paul D. Curtis* succeeds Mr. Callison as assistant district manager of the American Locomotive Company at Chicago and continues also as president of the Marquette Railway Supply Company, Chicago.

Joseph B. Ennis began his business career in 1895 as a tracer in the drafting room of the Rogers Locomotive Works. From 1899 to 1902 he held the position of elevation draftsman respectively with

Joseph B. Ennis

the Schenectady Locomotive Works, the Rogers Locomotive Works, and the Cooke Works, American Locomotive Company. In 1902 he was transferred to New York and placed in charge of designs and calculation-specifications for locomotives. In 1906 he was appointed assistant to the mechanical engineer and became successively designing engineer, chief mechanical engineer and, in 1917, vice-president in charge of engineering, which position he held until his present appointment.

James E. Davenport entered railway service in 1909 as a special apprentice at the West Albany shops of the New York Central and remained with that road until 1940. During that time he successively held positions as enginehouse foreman, dynamometer car engineer, train master, division superintendent, assistant to the assistant general manager, assistant to the executive vice-president and assistant chief engineer of motive power and rolling stock. In 1940 he left the New York Central to become assistant vice-president of engineering with the American Locomotive Company, which position he was holding

James E. Davenport

at the time of his recent appointment. During 1927-28 Mr. Davenport was president of the International Railway Fuel Association.

William A. Callison was born on June 17, 1905, at Hinton, W. Va., and was educated at St. John's Military Academy and Purdue University. He was employed in various departments of the Chicago, Indianapolis & Louisville for two years, and later worked in the research department of the International Nickel Company at Huntington, W. Va. In January, 1929, he entered the employ of the American Locomotive Company as a special apprentice and in March, 1931, was transferred

William A. Callison

to the sales department at Chicago. In March, 1940, Mr. Callison became assistant district sales manager.

◆

Fitzwilliam Sargent has been appointed representative of the railroad division of the Edward G. Budd Manufacturing Company, with headquarters at the Philadelphia, Pa., plant. Mr. Sargent, who will be associated with S. M. Felton, eastern sales manager, was with the Standard Supply & Equipment Co. from 1915 to 1930, and was president of that company for three years.

◆

Union Asbestos & Rubber Co.—*P. S. Nash,* assistant vice-president of the Union Asbestos & Rubber Company, Chicago, has been placed also in charge of western railroad sales, with headquarters at Chicago. *George L. Green,* eastern sales representative, has been appointed assistant vice-president in charge of eastern railroad sales, with headquarters at Chicago. *J. B. Crawford,* office manager at Chicago, has been appointed service engineer, with headquarters at San Francisco, Calif.

P. S. Nash was formerly in the mechanical department of the Oregon Short Line at Pocatello, Idaho. He joined the Union Asbestos & Rubber Company in 1926, and later was located in Salt Lake City, Utah, and then in San Francisco as sales representative. In August, 1939, he was appointed assistant vice-president at Chicago.

G. L. Green, after his graduation from Yale-Sheffield Scientific School in 1931, was with the Continental-Illinois National Bank & Trust Company. In 1934, he entered the employ of the Union Asbestos & Rubber Company as sales engineer, covering certain portions of the southwestern and also the northwestern territories. In 1939 he was promoted to eastern sales representative.

◆

John B. Wright, assistant vice-president and district manager of the Westinghouse Air Brake Company, has been ap-

John B. Wright

pointed assistant to the president with headquarters at the general office in Wilmerding, Pa. Mr. Wright entered the service of the company in 1899 as a clerk in the engineering department. Later he became chief clerk of that department, and in 1906 took charge of engineering correspondence at the general office. He became assistant manager of the Pittsburgh district in 1920, and three years later was appointed also assistant to the vice-president, in charge of the commercial engineering division. In 1932 he became assistant vice-president. Mr. Wright now relinquishes this title, but will continue as manager of the Pittsburgh district in addition to his new duties as assistant to the president.

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Obituary

J. H. Bendixen, chairman of the board of directors of the Bettendorf Company, died December 3. Mr. Bendixen joined the Bettendorf organization in 1894 as foreman of the machine shops and subsequently held the positions of assistant superintendent, superintendent and general manager. In 1909 he was appointed vice-president of the company, which position he held until his retirement on September 1, 1938.

◆

Harry T. Gilbert, who retired as Chicago district sales manager of the Illinois Steel Company in 1936, died on December 27 at Pass Christian, Miss.

◆

Edward S. Dilley of the Standard Brake Shoe & Foundry Co., Pine Bluff, Ark., died December 15.

Personal Mention

General

Edward Greig Bowie, assistant superintendent of the Western Lines of the Canadian Pacific has been appointed superintendent of the motive power and car departments of the Western lines, with headquarters at Winnipeg, Man.

C. M. Wilburn has been appointed motive-power inspector of the Huntington division of the Chesapeake & Ohio, with headquarters at Huntington, W. Va.

Robert A. Pyne, superintendent of motive power and car department of the Western lines of the Canadian Pacific at Winnipeg, Man., retired January 1. Mr. Pyne was born at Toronto, Ont., on April 10, 1874, and entered railway service as a machinist apprentice on the

Robert A. Pyne

Canadian Pacific at Winnipeg in July, 1887, later being promoted successively at that point to machinist, main shop gang foreman, enginehouse shop foreman and assistant general foreman. In July, 1902, he was advanced to general foreman at Calgary, Alta., and in September, 1903, to acting master mechanic. In January, 1904, Mr. Pyne was appointed locomotive foreman at Brandon, Man., and in October, 1906, was promoted to division master mechanic at Moose Jaw, Sask., later being transferred successively to Nelson, B. C., and Calgary, Alta. In January, 1912, he became superintendent of shops at Winnipeg, and in August, 1916, was promoted to superintendent of the motive power and car departments, Eastern lines, with headquarters at Montreal, Que. Mr. Pyne was transferred to the Western lines, with headquarters at Winnipeg, in January, 1921, where he was located until his retirement on January 1.

Master Mechanics Road Foreman

Frank C. Watrous has been appointed trainmaster and road foreman of engines of the Pittsburg & Shawmut, with headquarters at Kittanning, Pa.

Paul Thomas, assistant master mechanic of the Philadelphia division of the Pennsylvania, has been promoted to master mechanic of the Chicago Terminal and Logansport divisions, at Chicago.

T. H. Callahan, traveling engineer on the Southern Pacific lines in Texas and Louisiana, at Victoria, Tex., has been promoted to the position of general road foreman, with headquarters at Houston, Tex.

F. E. Litz, assistant road foreman of engines, Pocahontas division of the Norfolk and Western, has been promoted to road foreman of engines of the same division.

R. N. Booker, district road foreman of engines on the Southern Pacific at Los Angeles, Calif., has become general air-brake inspector and general road foreman of engines, with headquarters at San Francisco, Calif.

William Henry Gimson, general foreman on the St. Louis-San Francisco at Springfield, Mo., has been promoted to master mechanic of the Southwestern and Western divisions, with headquarters at West Tulsa, Okla.

Shop and Enginehouse

John Elsee, foreman in the mechanical department of the Louisville & Nashville at Jackson, Ky., has been transferred to the position of night enginehouse foreman at Ravenna, Ky.

Obituary

Robert Blaine Spencer, master mechanic of the Southwestern and Western divisions of the St. Louis-San Francisco, with headquarters at West Tulsa, Okla., died on December 24 at Claremore, Okla.

Ray M. Brown, assistant to general superintendent of motive power of the New York Central, with headquarters at New York, who retired on December 31, 1940, after 41 years of service, died on January 17, after an illness of six months, at the age of 61.

John Leonard Driscoll, former New York Central fireman and master mechanic of the Catskill Mountain railroad, died at Catskill, N. Y., on January 2, at the age of 103 years. Known as Catskill's "grand old man," Mr. Driscoll started his railway career as a locomotive fireman on the Hudson River railroad (now New York Central) in 1863, and then joined the Dutchess & Columbia and the Poughkeepsie & Eastern (now New York, New Haven & Hartford) as an engineer. When the three-foot gage Catskill Mountain R. R. was opened in 1882, Mr. Driscoll was made superintendent motive power and master mechanic, which positions he held until the abandonment of the road in 1919.

Frederic Methven Whyte, who was for many years general mechanical engineer of the New York Central, died on January 2 at Tarrytown (N. Y.) hospital, after a brief illness, at the age of 75 years. Mr. Whyte was born on March 3, 1865, and was graduated from Franklin Academy in 1884 and Sibley College, Cornell University, in 1889. He entered railway service on May 1, 1889, as a draftsman in the motive power department of the Lake Shore & Michigan Southern (now New York Central), serving in that capacity until January, 1890, when he went with the Baltimore & Ohio and was employed in the testing department and drawing room at Baltimore, Md., until February 1, 1892. Mr. Whyte was engaged in special testing work for the Mexican Central railway at Mexico City from February to June, 1892, and in general railroad engineering in Chicago from June, 1892, to December, 1894, chiefly with the South Side Elevated road, and in railway newspaper work. He was draftsman for the Northwestern Elevated road at Chicago from July, 1895, to September, 1896, when he became consulting engineer at Chicago. Mr. Whyte served as mechanical engineer for the Chicago & North Western and secretary of the Western Railway Club from July 1, 1897, to August 10, 1899, then becoming mechanical engineer for the New York Central & Hudson River (now New York Central). From November 1, 1904, to 1910 he was general mechanical engineer for the same road, the Lake Shore & Michigan Southern, the Boston & Albany, the Lake Erie & Western, and the Indiana, Illinois & Iowa. From September 15, 1905, to 1910, Mr. Whyte was also general mechanical engineer of the Rutland. On November 1, 1911, he went with Hutchins Car Roofing Company as vice-president. In 1921 he was the only American member of the Uniform Gage Commission, appointed by the Australian government to work out a system of unification of railroad gages in Australia. Mr. Whyte retired five years ago.

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Railway Mechanical Engineer

March 1941

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RAILWAY
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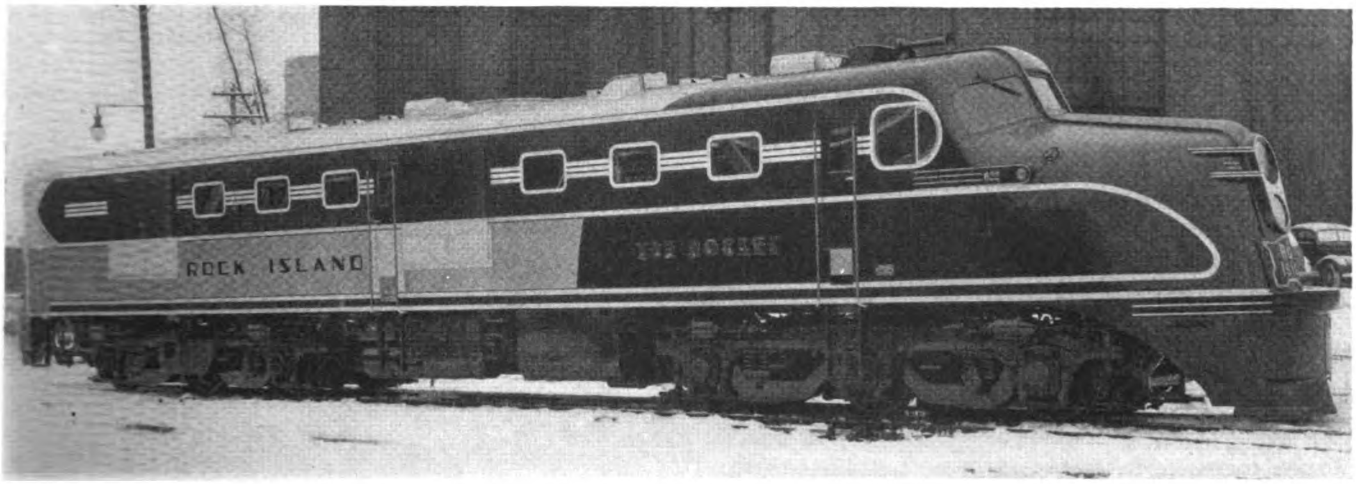


Rock Island Buys Alco-G.E.

2,000-Hp. Road Locomotives

Passenger motive power designed for 120 m. p. h. has six-wheel trucks and a total weight of 330,000 lb.—Tractive force, 53,000 lb.

THE American Locomotive Company recently delivered to the Chicago, Rock Island & Pacific two Alco-G. E. 2,000-hp. road passenger locomotives for service on the "Arizona Limited" between Chicago and Tucumcari, Ariz. These locomotives are each powered by two 1,000-hp. Alco turbo-charged Diesel engines and are equipped with electric generating, traction and control equipment built by the General Electric Company. The locomotives have six-wheel trucks and are designed for a maximum speed of 120 m. p. h. The total weight is 330,000 lb. and the starting tractive force, at 24 per cent adhesion, is 53,000 lb.

Construction Details

The general structure of these locomotives consists of a welded steel underframe on cast-steel, six-wheel trucks with a cab having a sloping front end and a conventional passenger-car-type vestibule at the rear end. The air brake and train-control equipment is located under the low hood at the forward end and this space is entered through a door from the operator's compartment. The latter compartment, 7 ft. 6½ in. long, has exterior doors at both sides of the locomotive and doors on both sides leading into the engine compartment.

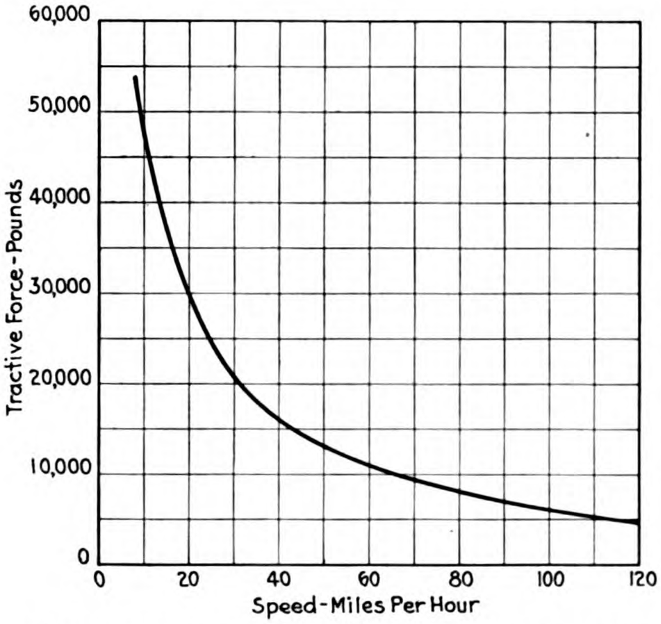
The two engines are located on the center line of the locomotive with the main and auxiliary generators and turbo-chargers at the forward end of each engine and the air compressors and radiator ventilating fans at the rear end of each engine set. The engine compartment is approximately 47 ft. long. Two Vapor Clarkson 1,600-lb. per hr. steam generators for train heating are located at the left side of the rear end of the cab. A radiator chamber is located at the rear of each engine and is arranged with two standard 11-section radiators, one on each side of the locomotive. Each engine and its cooling equipment is an individual unit. The cooling is accomplished by drawing air into the radiators in the side of the locomotive and discharging it from the roof. The 54-in. radiator fans are located in funnels just under the roof to which the radiator plenum chambers are connected. A total of 17 radiator sections are used for cooling engine water and 5 sections for cooling lubricating oil. Each radiator is equipped with manually-operated shutters.

Ventilators are located in the roof of the engine compartments to provide cool air for the engine, traction blowers, boilers, etc., and to discharge heated air from the engine room.

Underframe and Cab

The underframe is of welded construction employing standard rolled sections. The center sills are H-beams 12 in. deep with bolsters of plate and I-beam construction forming a rigid box section. The center plates and draft-gear housings are steel castings, the former being welded to the underframe and the latter riveted. The center plates are protected from wear by steel liners lubricated from oil cups located in the engine compartment.

The cab framing is of truss design, welded throughout, using standard rolled sections. The cab roof is of semi-elliptic cross sections framed of rolled sections welded



Tractive force-speed curve of the 2,000-hp. Rock Island locomotive

together and riveted to the side frames. Hatchways are provided in the roof for the removal of engines, generators and train heating boilers. The main hatches also have smaller openings with hinged covers as a means of access for the inspection and removal of pistons.

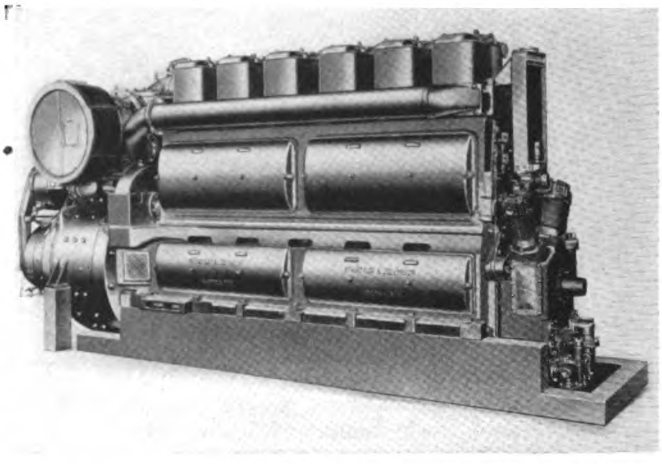
The walls and the roof of the operator's cab are lined inside with metal sheathing and the space between this sheathing and the outer covering is filled with insulating material. The bulkhead between the operator's cab and the operator's compartment is an insulated wall. All of the cab doors are of metal construction or metal covered. In addition to the two side exit doors in the operator's compartment there are side exit doors at the approximate center of the engine compartment.

The windows across the front of the operator's cab and in the side walls of the engine compartment are the fixed type with rubber weather seals. The side windows of the operator's cab are the combination type with a controlled drop section and a front section hinged for ventilation. All window frames are of metal construction and all windows are fitted with safety glass. There are window wipers, defrosters, and sun visors for both front windows.

The Diesel Engines

The locomotive is powered by two Alco six-cylinder, vertical, four-cycle, turbo charged* Diesel engines developing 1,000-hp. at normal running speed of 740 r. p. m. These engines have a bore of 12½ in. and a stroke of 13 in. The engine base is cast aluminum alloy. In basic design, these engines are identical to the engines used in Alco-G. E. switching locomotives. However, because of the higher average load factor of the engines in road service, a different cylinder head is used which embodies slightly larger valves and larger port areas than the cylinder head used on the switcher engine. At the full load of the engine, the turbo-chargers operate at moderate speeds, approximately 30 per cent below their normal designed speed. The use of cast aluminum engine bases on the engines for the road locomotive is for the purpose of reducing weight.

Another point of difference in these engines is the built-in air-brake compressor. In co-operation with the



One of the turbo-charged 1,000-hp. Alco Diesel engines showing the generators and two-stage compressor

Westinghouse Air Brake Company, a two-cylinder two-stage compressor was developed for direct attachment to the end of the engine opposite the generator. There is

* A detailed description of the Alco (Buchi System) turbo-charger appeared in the *Railway Mechanical Engineer* for August, 1937, page 339 and the results obtained with this system of supercharging were summarized in the August, 1938, issue, page 297.

A shop view of one of the six-wheel trucks and a cab under construction in the background

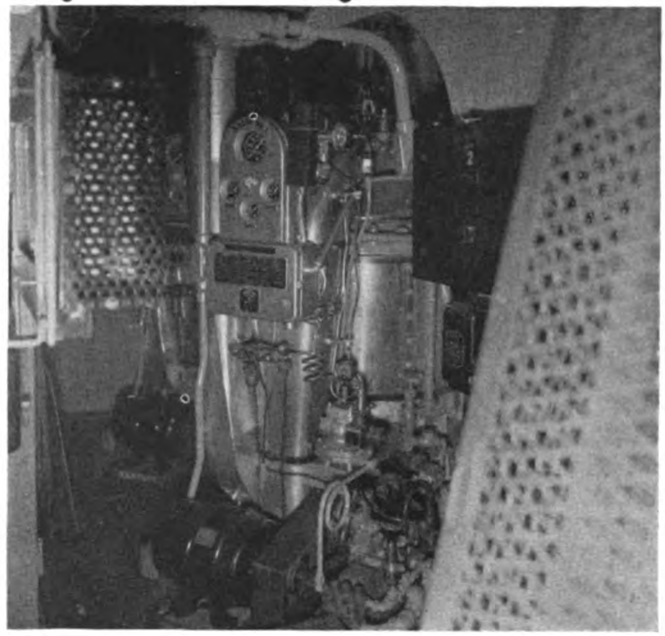
a crankshaft extension bolted to the end of the Diesel engine crankshaft for the compressor cylinder connecting rods. The intercooler for this compressor is mounted on the end of the engine above the compressor itself. This compressor has a displacement of 114 cu. ft. per min. at full engine speed or a total of 228 cu. ft. per min. for both compressors. The engine lubricating oil pump is mounted inside this air-brake compressor crankcase and is driven from the crankshaft extension.

Provision is made by the extension of this crankshaft beyond the compressor for the V-belt pulleys which drive the radiator fan for each engine and the traction-motor blower fan in the case of the No. 2 engine. On the No. 1 engine this fan is driven by an extension of the generator shaft.

Electrical Equipment

Capacity ratings of the electric-drive equipment have been made ample to meet all service requirements. Several improvements have been incorporated in the design including a special control for maintaining the engine load.

Each of the two engines drives a direct-connected main generator, an auxiliary generator, mounted on an extension of the shaft of the main generator, and a split-pole exciter mounted on the top of the auxiliary generator. The main generator has ample capacity to convert the available output of the engine and a special feature is incorporated in the form of a speed switch mounted on the end of the exciter shaft which keeps the engine fully loaded regardless of altitude, temperature or other variable conditions.



The two steam generators

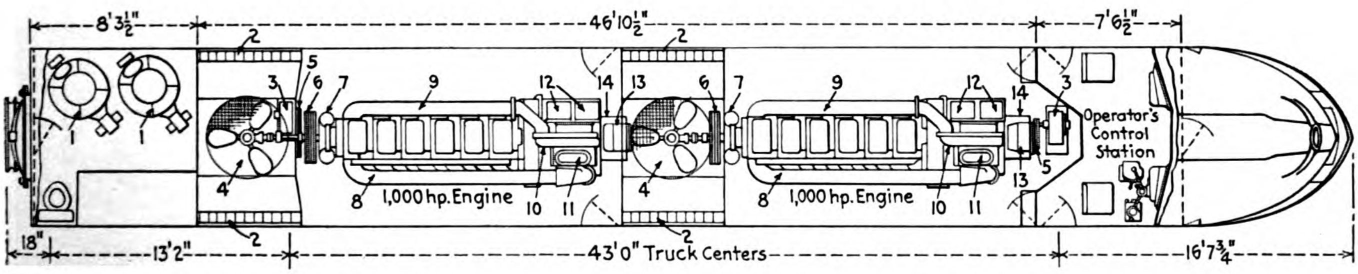
General Characteristics of Rock Island 2,000 Hp. Diesel-Electric Road Locomotives

Total engine brake horsepower (for traction)	2,000
Driving motors, number	4
Maximum speed restriction, m.p.h.	120
Driving wheels, (four pairs) diameter, in.	40
Idling wheels, (two pairs) diameter, in.	40
Wheel base, truck, rigid, ft.-in.	15-4
Wheel base, total locomotive, ft.-in.	58-4
Weights:	
On driving wheels, lb.	220,000
On idling wheels, lb.	110,000
Total locomotive, lb.	330,000
Maximum overall dimensions:	
Height, roof, ft.-in.	13-6
Height, maximum, ft.-in.	14-4
Width, inside cab sheets, ft.-in.	9-9
Width, maximum, ft.-in.	10-6
Length, overall, ft.-in.	74-9¼
Starting tractive force, (at 24 per cent adhesion), lb.	53,000
Maximum radius curvature, deg.	21
Lubricating oil capacity, per engine, gal.	80
Fuel oil capacity, total, gal.	1,200
Engine cooling water capacity, per engine, gal.	325
Boiler water capacity, gal.	1,000
Sand capacity, cu. ft.	20

The auxiliary generator has a rating of approximately 11 kw., and supplies power to control circuits, lighting circuits and all auxiliaries that are electrically operated as well as power for charging the 32-cell, KT 35, Exide battery having an eight-hour rating of 291 amp.-hr. The armature is mounted on the main generator shaft extension and the frame of the generator is bolted to the main generator bearing bracket. The auxiliary circuit voltage is held constant at 75 volts throughout the speed range of the engine by a voltage regulator.

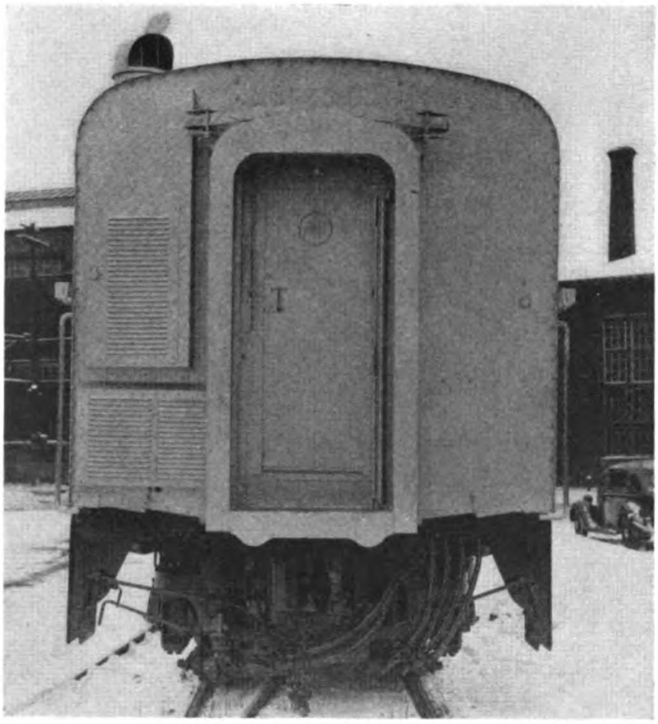
The exciter which furnishes excitation for the main generator is mounted on the top of the generator frame and is belt driven from the main engine shaft. This exciter is a split-pole machine with a special magnetic circuit which maintains generator horsepower constant throughout the normal speed range of the locomotive.

Current from the two main generating plants is supplied to four GE-730 single-geared traction motors of the conventional four-pole, commutating-pole design. Constant oil level bearings are used for the axle bearings. A feature of this equipment is the forced oil lubrication of the gear and pinion. By use of an oil-tight and dust-tight gear case and special construction of the gear and pinion, a constant stream of fresh oil is supplied at the point of contact by forcing out the lubricant through holes in the gear rim. The gear rim is a separate part



1—Steam generator
2—Radiators
3—Traction motor blowers
4—Radiator fans
5—Belt drive for motor blower
6—Belt drive for radiator fan
7—Two-stage air compressor
8—Exhaust manifold
9—Intake manifold
10—Turbo-charger blower
11—Turbo-charger exhaust
12—Air inlet for turbo-charger
13—Exciter
14—Auxiliary generator

Plan of Alco-G. E. 2,000-hp. Diesel-Electric locomotive for the Rock Island



At the rear end is a standard passenger-car vestibule

bolted to the hub so as to eliminate distortion and maintain the teeth in shape and correct alinement. Both armature bearings are of the roller type and the armatures are dynamically balanced. Both the bearings and shafts are made unusually large to allow an adequate safety factor. The gearing (58/25) permits a maximum safe speed of the locomotive of 120 m. p. h.

The conventional control for locomotives of this type is so arranged that there are two completely independent power plants from each of which two motors are first started in series, then transferred to parallel and from parallel to reduced field connection. Provision is also made for the operation of locomotives of this type in multiple.

Power supply is regulated in eight steps by the controller handle at the engineer's position. The motor connections on each power plant are changed automatically to the several operating positions. These connections are controlled by relays which effect the transfer of connections not only at reduced speed but over the entire range of operation. These relays also disconnect the field-shunting contactors if the locomotive speed drops to a point below the predetermined range for shunt-field operation.

Direction of movement of the locomotive is controlled by a small reverse handle in the master controller. This has three positions, forward, off and reverse. Wheel-slipping relays operate an indicating lamp to warn the engineer of wheel slipping while the motors are operating in series, and prevent transferring to parallel operation while this condition exists. These lights also flash momentarily during transfer to parallel to give indication of the operation on each power plant.

Trucks, Draft Gear and Brake Equipment

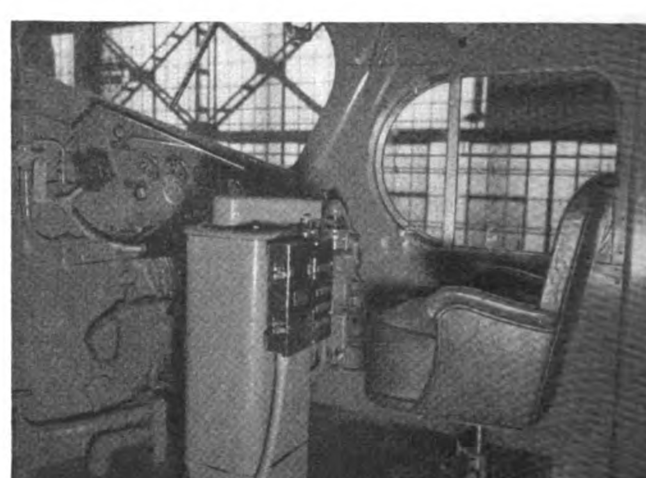
The trucks under these locomotives are six-wheel pedestal-type trucks with one-piece cast-steel frames, side equalizers, coil springs and swing bolsters carried by semi-elliptic springs at four corners. The trucks are arranged for the application of motors to the end axles, the middle axle being an idler. The motors are ventilated through the truck center plates. The wheel and

Partial List of Material and Equipment on the Rock Island 2,000 Hp. Road Locomotives

Conduit (aluminum)	Aluminum Co. of America, Pittsburgh, Pa.
Electrical equipment	General Electric Company, Schenectady, N. Y.
Storage battery (Exide)	Electric Storage Battery Co., Philadelphia, Pa.
Soundproofing; Burgess acoustic	Pyle-National Company, The, Chicago
Pipe covering	Union Asbestos & Rubber Co., Chicago
Radiator fans	General Electric Company, Schenectady, N. Y.
Shutters	Kysor Heater Co., Cadillac, Mich.
Air-compressor strainers; air-compressor intercooling units	Westinghouse Air Brake Co., Wilmerding, Pa.
Motor trucks	General Steel Castings Corp., Eddystone, Pa.
Truck wheels, rolled steed	Carnegie-Illinois Steel Corp., Pittsburgh, Pa.
Roller bearings; roller-bearing heat indicator	The Timken Roller Bearing Co., Canton, Ohio
Springs	American Locomotive Co., Railway Steel Spring Div., New York
Couplers; Coupler yokes; draft gear	National Malleable and Steel Castings Co., Cleveland, Ohio
Truck, clasp, brake	American Steel Foundries, Chicago
Brake, operating; slack adjuster; brake cylinders, aluminum	Westinghouse Air Brake Co., Wilmerding, Pa.
Brake shoes	American Brake Shoe & Foundry Co., New York
Hand brake	National Brake Co., Buffalo, N. Y.
Cab doors	The Morton Mfg. Co., Chicago
Cab doors	Haskelite Mfg. Corp., Chicago
Tread plate, aluminum; partition plates	Aluminum Co. of America, Pittsburgh, Pa.
Vestibule diaphragm	The Morton Mfg. Co., Chicago
Vestibule buffer spring	Standard Railway Equipment Mfg. Co., Chicago
Operator's compartment, drop sash; window glass moulding	O. M. Edwards, Inc., Syracuse, N. Y.
Operating compartment seats	Heywood-Wakefield Co., Gardner, Mass.
Vestibule curtain	The Adams & Westlake Co., Elkhart, Ind.
Train steam heat equipment	Vapor Car Heating Co., Inc., Chicago
Air horns	Westinghouse Air Brake Co., Wilmerding, Pa.
Speed indicator	General Electric Company, Schenectady, N. Y.
Side-wall panels	Haskelite Mfg. Corp., Chicago
Insulation	Johns-Manville Sales Corp., New York
Sanders	Graham-White Sander Corp., Roanoke, Va.
Headlight; classification-lamp lens	The Pyle-National Company, Chicago
Dome lamp	Safety Car Heating & Lighting Co., New York
Classification lamp	American Locomotive Co., New York
Paint	E. I. duPont deNemours, Wilmington, Del.

axle assembly can be removed with or without the motors. The truck wheels are 40 in. diameter mounted on axles of open-hearth steel with 7-in. journals carried in Timken roller bearings. Clasp brakes are used on all wheels. Automatic and straight-air brakes are applied to all wheels. The operating brake schedule is Westinghouse HSC.

The locomotives are equipped with National M-350-A draft gear and National tight-lock couplers, front and rear. The coupler at the front end is the concealed swivel type.



The controls at the engineman's station

Twenty-Ninth Annual

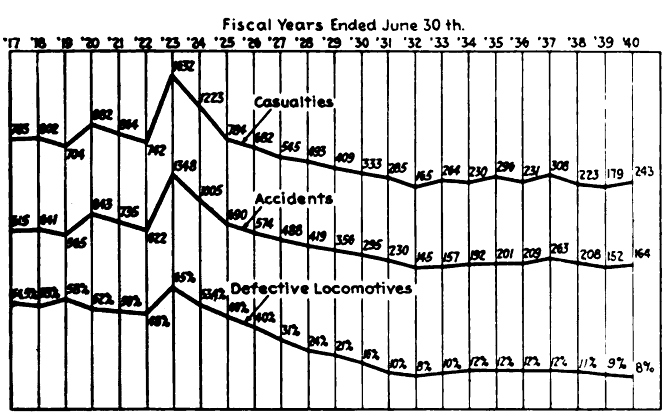
Locomotive Inspection Report

Number of casualties and accidents increase although condition of steam locomotives improves as the percentage of defective locomotives equals record low of eight in 1932

THE annual report of the Bureau of Locomotive Inspection, Interstate Commerce Commission, submitted by John M. Hall, director, covering the fiscal year, ended June 30, 1940, shows that eight per cent of the steam locomotives inspected were found defective, a decrease of one per cent as compared with the previous year. However, the 164 accidents, resulting in 18 deaths and 225 injuries, which occurred in connection with steam locomotives, represents an increase of 12 accidents, an increase of three in the number of deaths and an increase of 61 in the number of persons injured as compared with the previous year.

The accompanying chart shows the percentage of defective steam locomotives, the number of accidents and the number of casualties for the years ended June 30, 1917, to 1940, inclusive. Summaries and tables included in the report show separately accidents and other data in connection with steam locomotives and tenders and their appurtenances and similar data for locomotives other than steam.

In addition to the accidents referred to in the report, two accidents resulting in injuries to four employees caused by explosions of torpedoes carried in metal containers attached to the backboards inside of the locomotive cabs, were reported to the Bureau by widely separated railroads. These accidents and two other explosions due to the same cause on one of the railroads,



Relation of defective steam locomotives to accidents and casualties

in which no injuries occurred, do not come within the scope of the locomotive inspection law but are mentioned in the report to emphasize the need for clean smooth-surface containers with the explosives properly placed therein and packaged so the contents will not leak out.

Reports were filed for 44,274 locomotives during the year ended June 30, 1940, a decrease of 1,691 compared with the previous year. Of the 102,164 locomotives inspected, 8,565 were found defective and 487 were ordered out of service. For the previous year, 105,606 steam locomotives were inspected, 9,099 were found defective and 468 were ordered out of service. In the year ended June 30, 1938, 11,050 of the 105,186 steam locomotives inspected were found to be defective and 679 were ordered out of service. The total number of defects found and shown in the last three reports were 32,677 in 1940, 33,490 in 1939, and 42,214 in 1938.

Table I shows the number of casualties resulting from steam locomotive accidents classified according to occupation. Table II shows the parts found defective on steam locomotives and gives data on inspections and reports. Similar data for locomotives other than steam are given in Table III.

During the last fiscal year, eight boiler explosions occurred in which 12 persons were killed and 15 were injured. All of these explosions were caused by overheating of the crown sheet due to low water. Boiler and appurtenance accidents, other than explosions, resulted in the death of four persons and injuries to 95.

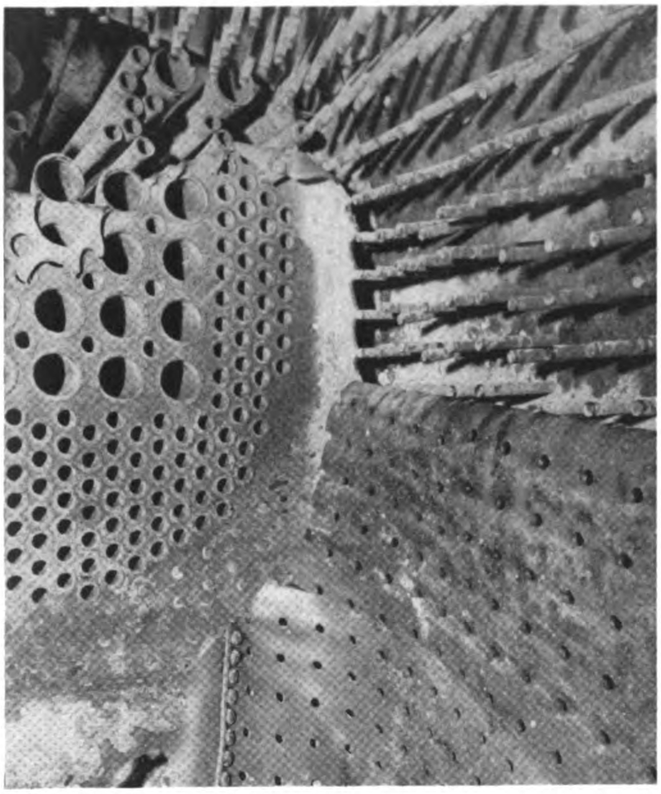
Locomotives Other Than Steam

For locomotives other than steam, reports were filed covering 2,987 locomotives in the year ended June 30,

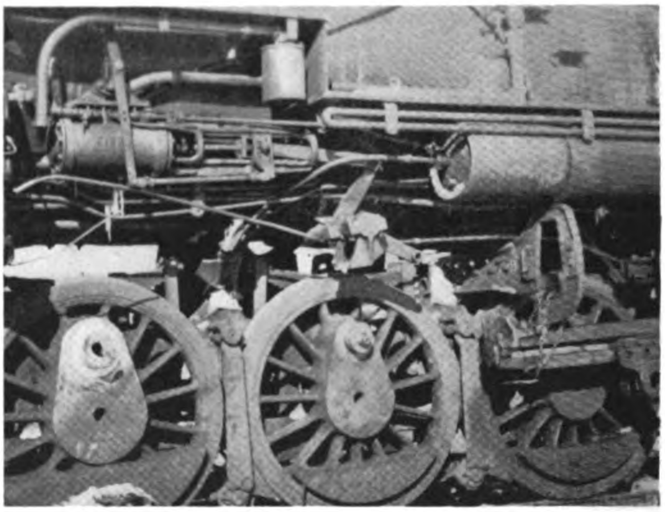
Table I—Number of Casualties Classified According to Occupation—Steam Locomotive Accidents

	Year ended June 30									
	1940		1939		1938		1937		1936	
	Killed	Injured	Killed	Injured	Killed	Injured	Killed	Injured	Killed	Injured
Members of train crews:										
Enginemen	5	70	4	46	3	70	8	106	4	75
Firemen	6	49	6	66	2	80	5	78	6	72
Brakemen	4	24	2	18	...	31	3	30	3	28
Conductors	1	4	...	5	...	6	1	18	...	13
Switchmen	...	4	...	6	...	7	...	10	...	2
Roundhouse and shop employees:										
Boilermakers	1	3	1	1	...	2	2	2	...	...
Machinists	...	3	...	2	...	...	...	2	...	4
Foremen	...	...	...	...	...	1	...	...	...	3
Inspectors	...	...	...	...	...	1	...	...	...	2
Watchmen	...	1	...	1	2	...	1	1	1	1
Boiler washers	...	...	...	...	...	1	...	...	...	...
Hostlers	...	2	...	1	...	6	...	9	...	3
Other roundhouse and shop employees	...	1	...	2	...	1	...	3	...	3
Other employees	1	20	...	2	...	3	1	14	...	5
Nonemployees	...	44	2	14	...	7	4	10	2	4
Total	18	225	15	164	7	216	25	283	16	215

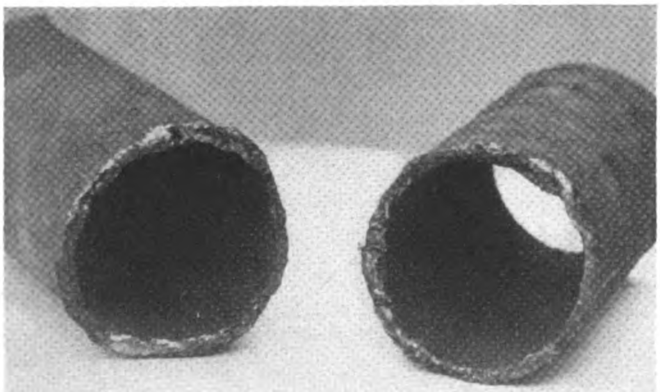
The overturned running gear and tender, damaged truck and two of six derailed passenger cars after a boiler explosion due to low water



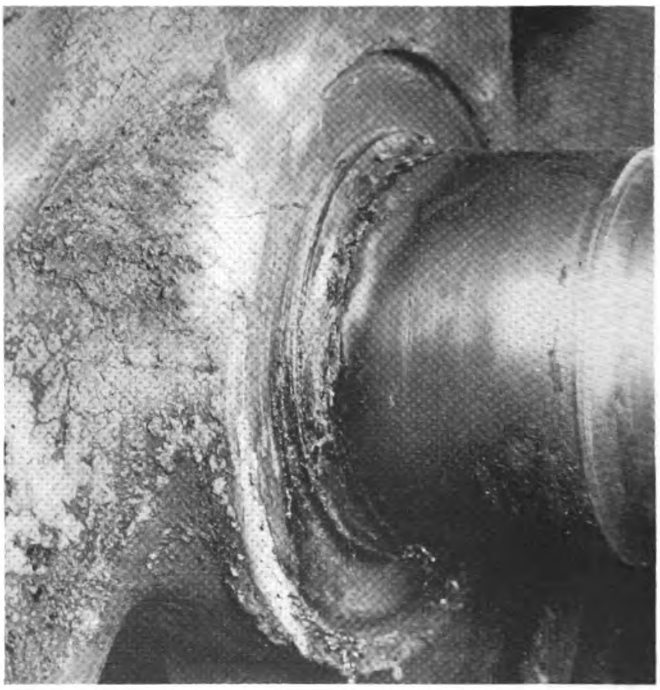
Firebox interior of the locomotive shown above after the explosion—Two employees were killed and eight persons were seriously injured



A broken main crankpin that failed while the locomotive was hauling a freight train at an estimated speed of 45 m.p.h.



A boiler tube that failed at a safe-end weld near the back flue sheet due to overheating at the time the weld was made



A crack in a main driving wheel that originated in fusion welding applied previously in an attempt to repair a crack of lesser extent

1940, an increase of 271 over the previous year. A total of 298, or six per cent of the 4,974 locomotive units inspected were found defective and 16 were ordered out of service. This is an increase of 38 in the number found defective, an increase of two in the total ordered out of service and no change in the percentage found defective.

Both the number of accidents occurring in connection with locomotives other than steam and the number of persons injured in these accidents increased from 5 to 7. No deaths occurred in either year.

Table II—Number of Steam Locomotives Reported, Inspected, Found Defective, and Ordered from Service

Parts defective, inoperative or missing, or in violation of rules	Year ended June 30					
	1940	1939	1938	1937	1936	1935
1—Air compressors	567	518	689	766	740	733
2—Arch tubes	20	28	66	105	74	74
3—Ashpans and mechanism	37	67	72	80	79	94
4—Axles	3	2	13	10	13	10
5—Blow-off cocks	191	204	226	199	236	283
6—Boiler checks	288	279	301	382	356	413
7—Boiler shell	266	272	331	347	383	396
8—Brake equipment	1,506	1,577	2,044	2,322	2,480	2,449
9—Cabs, cab windows, and curtains	1,078	943	1,226	1,807	1,638	1,273
10—Cab aprons and decks	277	260	326	466	450	368
11—Cab cards	101	92	109	145	166	142
12—Coupling and uncoupling devices	53	60	73	74	65	73
13—Crossheads, guides, pistons, and piston rods	815	739	905	1,160	1,056	1,086
14—Crown bolts	54	47	59	76	63	75
15—Cylinders, saddles, and steam chests	1,320	1,232	1,645	2,206	1,717	1,547
16—Cylinder cocks and rigging	447	418	585	729	605	627
17—Domes and dome caps	78	90	109	101	114	94
18—Draft gear	508	450	740	522	513	423
19—Draw gear	306	360	479	560	451	414
20—Driving boxes, shoes, wedges, pedestals, and braces	1,243	1,330	1,688	1,637	1,712	1,573
21—Firebox sheets	191	238	244	371	295	343
22—Flues	147	165	159	225	178	173
23—Frames, tail pieces, and braces, locomotive	665	708	1,001	1,053	997	1,006
24—Frames, tender	78	71	131	120	113	124
25—Gages and gage fittings, air	132	155	230	261	257	275
26—Gages and gage fittings, steam	211	226	279	324	350	320
27—Gage cocks	400	361	451	538	579	480
28—Grate shakers and fire doors	273	252	403	470	400	394
29—Handholds	333	349	405	510	502	464
30—Injectors, inoperative	30	26	26	38	40	39
31—Injectors and connections	1,330	1,457	1,784	2,020	2,085	2,035
32—Inspections and tests not made as required	6,218	6,645	8,204	9,638	9,005	8,344
33—Lateral motion	313	243	325	446	404	389
34—Lights, cab and classification	49	50	48	90	78	81
35—Lights, headlight	180	177	257	313	251	257
36—Lubricators and shields	185	200	212	254	255	191
37—Mud rings	213	248	203	272	237	241
38—Packing nuts	418	408	448	487	508	527
39—Packing, piston rod and valve stem	660	739	913	1,393	1,133	906
40—Pilots and pilot beams	140	104	154	133	178	152
41—Plugs and studs	156	179	238	238	236	167
42—Reversing gear	320	317	404	492	463	414
43—Rods, main and side, crank pins, and collars	1,199	1,293	1,669	2,348	2,093	1,826
44—Safety valves	61	97	125	132	125	100
45—Sanders	415	432	536	655	678	779
46—Springs and spring rigging	2,174	2,340	2,901	3,172	3,008	2,765
47—Squirt hose	50	75	94	133	134	113
48—Stay bolts	227	181	211	276	279	240
49—Stay bolts, broken	271	258	380	542	520	512
50—Steam pipes	255	285	410	446	526	463
51—Steam valves	106	115	141	165	227	212
52—Steps	449	490	631	678	615	640
53—Tanks and tank valves	768	837	955	1,009	877	913
54—Telltale holes	95	58	67	79	127	102
55—Throttle and throttle rigging	647	638	685	909	760	733
56—Trucks, engine and trailing	598	628	762	785	861	811
57—Trucks, tender	705	665	907	1,018	1,108	1,120
58—Valve motion	506	554	722	798	824	799
59—Washout plugs	478	487	626	598	714	679
60—Train-control equipment	2	5	11	12	6	4
61—Water glasses, fittings, and shields	753	690	915	1,049	1,118	951
62—Wheels	554	466	577	803	790	697
63—Miscellaneous—Signal appliances, badge plates, brakes (hand)	564	610	684	759	608	563
Total number of defects	32,677	33,490	42,214	49,746	47,453	44,491

	Year ended June 30					
	1940	1939	1938	1937	1936	1935
Locomotives reported	44,274	45,965	47,397	48,025	49,322	51,283
Locomotives inspected	102,164	105,606	105,186	100,033	97,329	94,151
Locomotives defective	8,565	9,099	11,050	12,402	11,526	11,071
Percentage of inspected found defective	8	9	11	12	12	12
Locomotives ordered out of service	487	468	679	934	852	921

Extension of Time for Removal of Flues

Applications filed for extensions of time for removal of flues, as provided in Rule 10, totaled 1,127. The investigations of the Bureau disclosed that in 85 of these cases, the conditions of the locomotives were such that extensions could not properly be granted. The condition of 35 locomotives were such that the full extensions requested could not be authorized, but extensions for shorter periods of time were allowed. Requests for 47 extensions were granted after defects disclosed by the Bureau's investigations were repaired. Twenty-seven applications were cancelled for various reasons. Requests were granted for the full period in 933 cases.

Under Rule 54 of the Rules and Instructions for Inspection and Testing of Steam Locomotives, 187 specification cards and 4,449 alteration reports were filed, check and analyzed.

Under Rules 328 and 329 of the Rules and Instructions for Inspection and Testing of Locomotives Other Than Steam, 335 specifications and 103 alteration reports were filed for locomotive units and 87 specifications and 35 alteration reports were filed for boilers mounted on locomotives other than steam.

No formal appeal by any carrier was taken from the decisions of any inspector during the year.

Table III—Number of Locomotives Other Than Steam Reported, Inspected, Found Defective, and Ordered from Service

Parts defective, inoperative or missing, or in violation of rules	Year ended June 30					
	1940	1939	1938	1937	1936	1935
Air Compressors	8	14	6	6	2	5
Axles, truck and driving	...	1	5	4	6	1
Batteries	1	1	1	4	...	7
Boilers	10	6	6	5	5	3
Brake equipment	50	50	74	97	66	46
Cabs and cab windows	22	36	25	51	30	33
Cab cards	13	18	11	25	...	...
Cab floors, aprons, and deck plates	17	13	8	17	10	6
Controllers, relays, circuit breakers, magnet valves, and switch groups	16	13	7	8	...	...
Coupling and uncoupling devices	6	4	4	3	...	...
Current-collecting apparatus	1	5	8	4	16	3
Draft gear	31	17	23	28	24	21
Draw gear	2	4	3	1	1	...
Driving boxes, shoes, and wedges	29	52	16	14	5	5
Frames or frame braces	12	9	37	5	15	4
Fuel system	51	35	47	152	44	15
Gages or fittings, air	1	6	11	1	6	4
Gages or fittings, steam	2	...	...	...	...	...
Gears and pinions	1	2	2	2	...	...
Handholds	6	8	13	11	8	3
Inspections or tests not made as required	207	185	204	237	186	124
Insulation and safety devices	2	4	13	13	20	15
Internal-combustion engine defects, parts and appliances	35	32	26	50	23	4
Jack shafts	7	6	1	...	1	...
Jumpers and cable connectors	...	1	1	2	...	...
Lateral motion, wheels	5	1	...	1	2	...
Lights, cab and classification	1	3	2	5	6	1
Lights, headlight	3	4	4	11	4	2
Meters, volt and ampere	4	2	2	1	2	...
Motors and generators	12	19	18	10	14	5
Pilots and pilot beams	10	6	1	7	6	5
Plugs and studs	...	...	...	1	...	...
Quills	4	7	6	3	...	...
Rods, main, side, and drive shafts	2	2	2	23	2	10
Sanders	34	28	37	52	25	21
Springs and spring rigging, driving and truck	50	16	43	36	29	20
Steam pipes	4	...	5	1	2	...
Steps, footboards, etc.	22	18	23	13	...	...
Switches, hand-operated, and fuses	3	5	7	2	2	2
Transformers, resistors, and rheostats	1	1	3	...	...	1
Trucks	43	33	40	41	42	46
Water tanks	...	1	...	1	...	...
Water glasses, fittings, and shields	1	1	3	...	4	6
Warning signal appliances	...	1	3	2	1	...
Wheels	22	16	11	21	26	6
Miscellaneous	15	10	7	20	39	25
Total number of defects	766	696	769	991	674	449
Locomotive units reported	2,987	2,716	2,555	2,416	2,361	1,911
Locomotive units inspected	4,974	4,581	4,024	3,615	3,118	1,620
Locomotive units defective	298	260	274	328	252	146
Percentage inspected found defective	6	6	7	9	8	9
Locomotive units ordered out of service	16	14	9	24	11	5

Standing Locomotive Tests*

Part II

By W. F. Collins †

Selection of exhaust nozzle and comparison of test results obtained with standard and improved front-end arrangements

It is believed that the laws governing the operation of the locomotive exhaust nozzle are the same as apply to any steam nozzle. There is no question that the nozzle design of the steam turbine or the ejector nozzle has been highly refined as compared with the design of the steam locomotive nozzle. High exhaust pressure decreases the work done in the cylinders and, therefore, it is desirable to reduce the exhaust pressure without lowering the efficiency of the smokebox arrangement.

The circular exhaust nozzle without the basket bridge was tried but it was impossible to fill the large diameter stacks and obtain the higher rates of evaporation. Experiments made by varying the length of the nozzle indicated that a nozzle length over one diameter did not improve the performance but slightly increased the exhaust pressure and decreased the coefficient of discharge. A number of tests indicated that the single circular nozzle with the basket bridge gave results equal to those obtained with the multiple orifices, viz., pepper box, annular-ported, and the star-shape nozzles. For mechanical simplicity, cost, and performance the circular nozzle was considered preferable to the other designs.

Because the steam of the locomotive cylinders is exhausted to the atmosphere below and above the critical pressure, a compromise is required in the contour of the circular nozzle. Consideration must be given in the design to the use of a convergent or divergent nozzle and whether the nozzle will be under- or over-expanding. At all pressures above 11 lb. per sq. in., the exhaust steam passes through the critical pressure and the use of the divergent nozzle is desirable. At pressures below 11 lb. per sq. in., a convergent nozzle is desirable. Below 11 lb. per sq. in., the excess air is higher; above 11 lb. per sq. in., the excess air is lower than desired. An attempt is made in this design to improve combustion conditions at the upper firing rates by selecting a divergent nozzle.

Fig. 7 shows the relation of the steam flow through an ideal circular nozzle for a specific state of the exhaust steam and the development of the shape of the nozzle. Results with this nozzle are shown under the paragraph "Rates of Evaporation".

Exhaust Pressure

The results of the *A* and *B* series have been superimposed on Fig. 8 to show the relation existing between the exhaust pressure, the steam to the nozzle and the dry air supplied per hour. On the basis of dry air supplied, the *ZM* series is far superior to the *A* series. At exhaust pressures of 4, 8 and 12 lb. per sq. in., the improved front-end arrangement supplied 5,000, 12,000 and 11,000 lb. more dry air per hr. than was obtainable with the standard front-end arrangement or an increase of 10, 18.5 and 7.4 per cent, respectively.

At exhaust pressures up to about 15 lb. per sq. in., nearly 20 per cent more air was supplied during the *ZM* series, and at 20 lb. per sq. in. pressure 15 per cent more air was supplied than during the *B* series. The exhaust pressures during the *ZM* series ranged from 0.5 to 1.5 lb. per sq. in. higher than they were for the *A* series at corresponding steam rates. This increase in pressure can be attributed to the difference in efficiencies of the nozzle and exhaust pipes for the two series. The exhaust pressure during the *ZM* series with the 7⅜-in. nozzle was about 30 per cent lower than for the *B* series with the 6¾-in. nozzle and at equal rates of steam to the nozzle.

Dry Air Supplied and Used in Combustion

The dry air supplied and the theoretical dry air used for complete combustion of the coal actually burned per square foot of grate per hour are plotted in relation to the firing rate in Fig. 9. The air supplied and the air used per pound of dry coal fired have been plotted to give a clearer illustration of the air available and the air used for combustion.

The results of the *A* and *B* series have been superimposed upon this graph for ease of comparison between the series. A study of the curves will explain why it was possible to obtain better combustion with the improved front-end arrangement during test series *ZM* than could be obtained during the standard front-end arrangement test series *A* and *B*, and why it was possible to attain higher firing rates during the former series.

The dry air supplied during the *ZM* series was much greater than for the *A* series, whether based on the coal rate or the steam to the nozzle. Since the mixed smokebox gases are products of combustion, depending for the greater part on the dry air supplied, the weight of mixed smokebox gases is naturally higher for the *ZM* series than it was for the *A* series at corresponding rates. This difference in weight of gases amount to about 7,000 lb. or 14.3 per cent at 30,000 lb. of steam to the nozzle, and 12,000 lb. or 12.3 per cent at 65,000 lb. of steam to the nozzle.

At a steam rate through the nozzle of 30,000 lb. per hr. there was hardly any difference between the *ZM* and *B* series in the weight of gases moved per pound of steam, but at rates of 45,000 and 60,000 lb. per hr. the weight of gases moved per pound of steam through the nozzle during the *ZM* series was 7.0 and 6.6 per cent, respectively, higher than for the *B* series. The fact that a greater weight of gases was moved per pound of steam at a reduction in exhaust pressure of about 30 per cent indicates a decided advantage in favor of the improved front-end arrangement with a 7⅜-in. nozzle over the standard front end with a 6¾-in. nozzle, as operated in road service.

The efficiencies of heat absorption and combustion,*

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* Part II of a paper presented at the annual meeting of the Railway Fuel and Traveling Engineers' Association on October 23, 1940, at Chicago. Part I appeared in the February, 1941, issue.

† Engineer of tests, New York Central

* This is in conformity with the theory presented by Lawford H. Fry in his book, "A Study of the Locomotive Boiler," Simmons-Boardman Publishing Company, 1924.

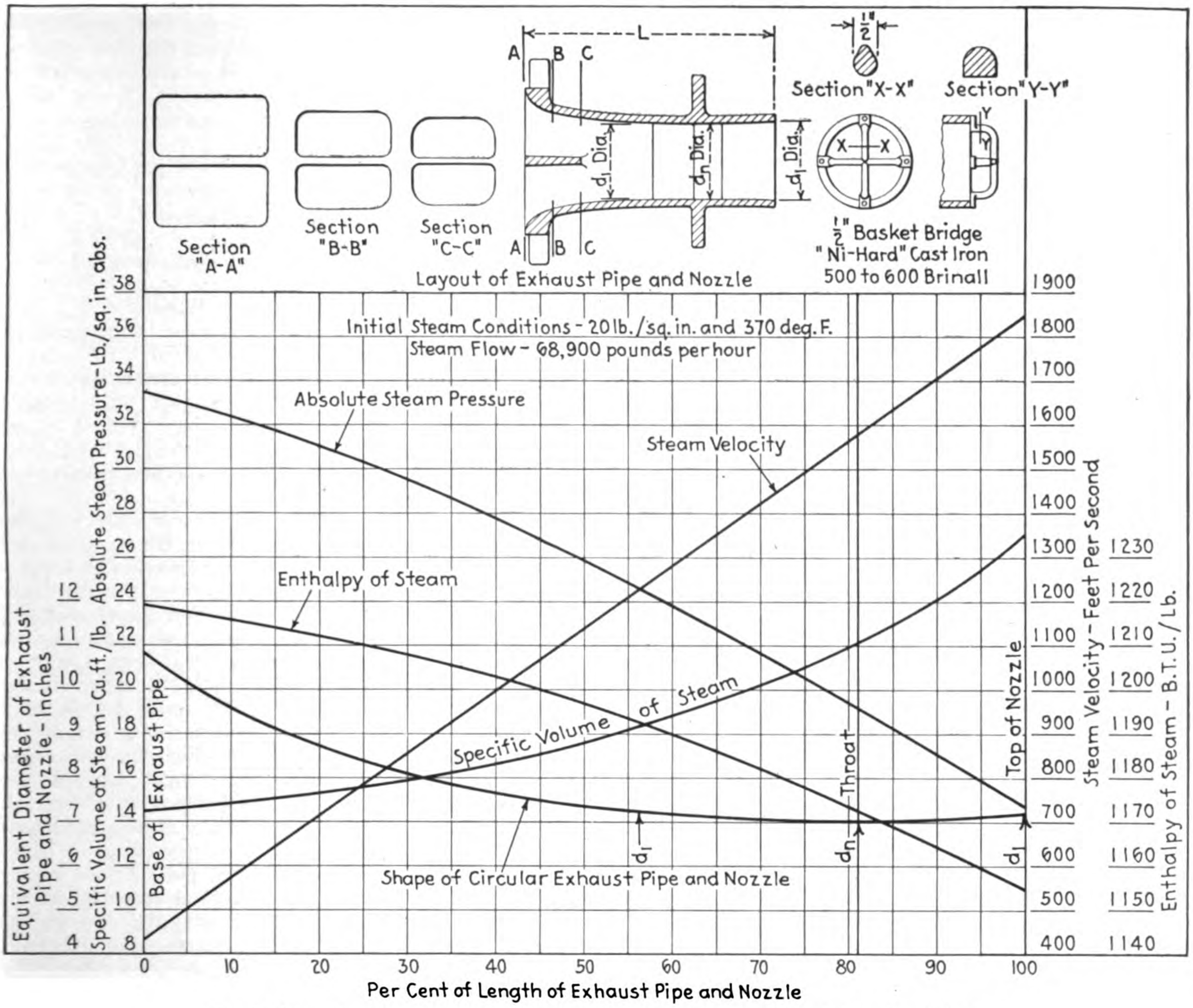


Fig. 7—Steam flow through an ideal circular nozzle for a specific state of the exhaust steam

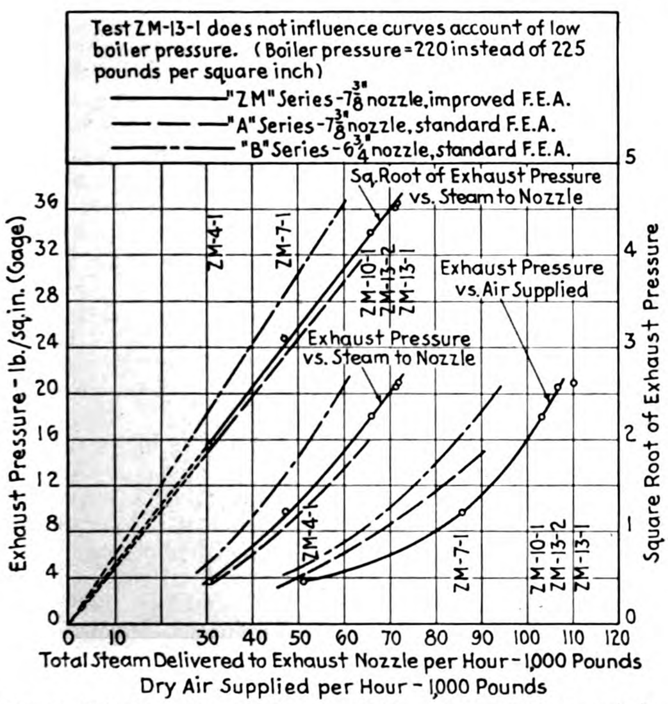


Fig. 8—Relation between exhaust pressure, steam to nozzle and dry air supplied per hour

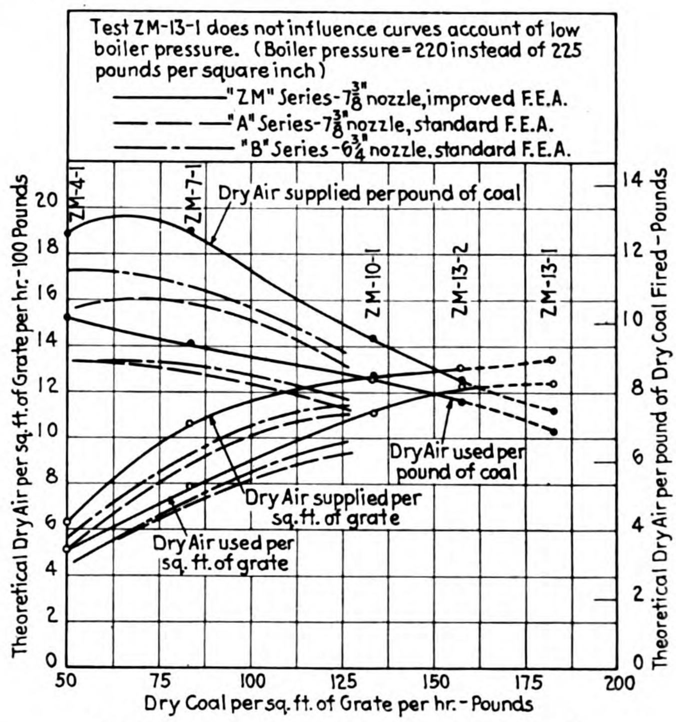


Fig. 9—Theoretical dry air versus rate of combustion

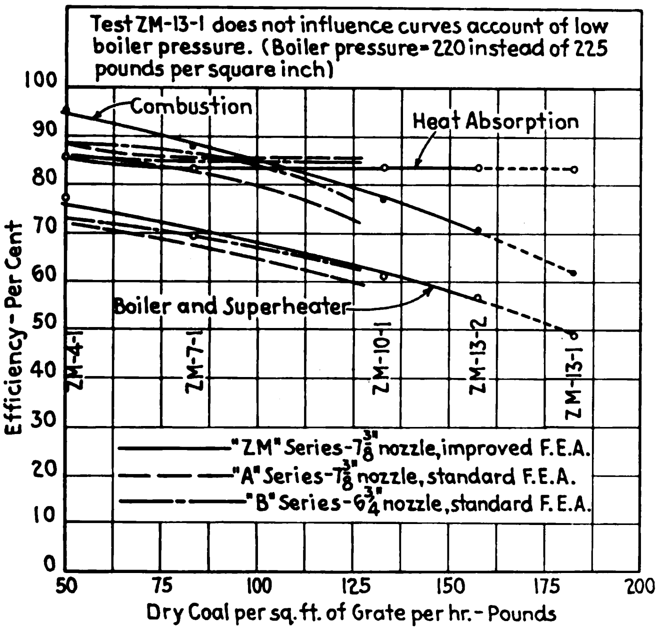
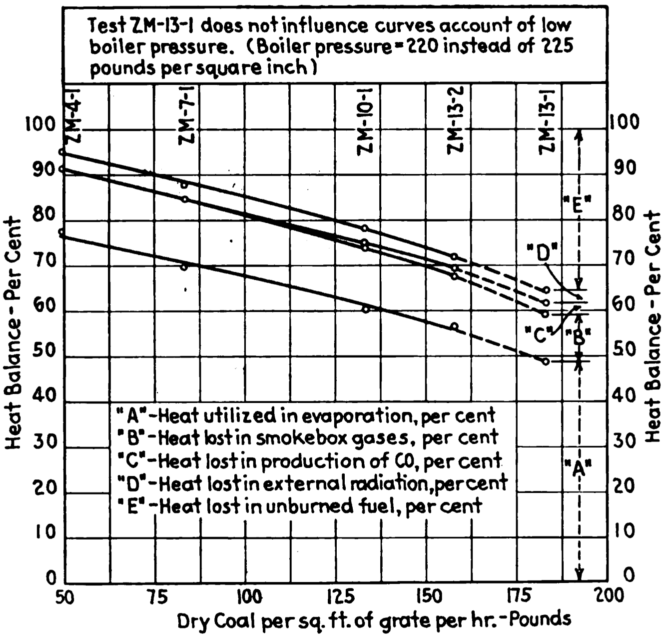


Fig. 10—Boiler and superheater, combustion, and heat absorption efficiencies versus rate of combustion

the latter in reality being the efficiency of the furnace, are plotted in relation to the firing rate in Fig. 10. The efficiency of the boiler plus the superheater is also included on this graph.

Throughout the range in which tests were conducted during the *A* series, the *ZM* series shows a decided improvement in performance, especially at the low and high rates. The efficiency of the boiler plus the superheater was increased from 4.5 to 6.8 per cent and the efficiency of combustion was from 6.4 to 9.0 per cent higher for the *ZM* series. The capacities of the boiler and furnace were



Proximate Analysis of Dry Coal	
Fixed carbon, per cent	55.26
Volatile matter, per cent	39.16
Ash, per cent	5.58
	100.00
Moisture, per cent	2.06
Sulphur, per cent	1.95

Ultimate Analysis of Dry Coal	
Carbon, per cent	78.57
Hydrogen, per cent	5.28
Oxygen, per cent	7.06
Nitrogen, per cent	1.58
Sulphur, per cent	1.93
Ash, per cent	5.58
	100.00

B.t.u. per lb. of dry coal	13,919
B.t.u. per lb. of coal, as fired	13,630

Fig. 11—Relation between heat balance and rate of combustion

increased approximately 15 to 22 per cent, respectively. The improved front-end arrangement supplied more air at normal firing rates than was obtainable with the standard front-end arrangement and sufficient air at much higher firing rates which accounts for its superiority over that design.

The results of the *ZM* series shows an improvement over those of the *B* series. The efficiency of the boiler plus the superheater was increased from 0.8 to 4.1 per cent and the efficiency of combustion for the *ZM* series was from 2.1 to 6.8 per cent higher than for the *B* series. The capacities of the boiler and furnace were increased about 12 to 14 per cent, respectively. These improvements in performance by the use of the improved front-end arrangement were obtained with a reduction in exhaust pressure of from 20 to 30 per cent at equal rates of steam to the nozzle. In road service, this reduction in exhaust pressure should result in increased engine horsepower output and with the increased combustion efficiency should result in a higher thermal efficiency of the locomotive.

The efficiency of combustion for the *ZM* series is higher than that for the *A* series while the efficiency of heat absorption is from 2 to 2½ per cent lower. Off hand, it might be assumed that the heat absorbed by the boiler during the *ZM* series was less than that absorbed during the *A* series but this is not true. The reason for the efficiency of heat absorption in per cent being lower for the *ZM* series than for the *A* series is that more air was supplied per pound of coal in the *ZM* series than in the *A* series, resulting in a greater proportion of the coal fired being burned. This increased the efficiency of combustion, which is the ratio of the heat produced in the firebox to that available in the coal fired, but the heat absorbed by the boiler does not increase in as great a proportion as the heat produced in the firebox because of the increase in the heat lost in the flue gas. Consequently, while more heat per pound of coal is absorbed by the boiler during the *ZM* series than during the *A* series, the ratio of heat absorbed to the heat produced, or efficiency of heat absorption, becomes less for the *ZM* series.

Heat Balance

The heat balance has been plotted in Fig. 11 in relation to the rate of firing. The heat utilized and the heat losses are enumerated and identified on the graph; the sum total being 100 per cent. A typical analysis of the coal used during these tests is also shown with this graph.

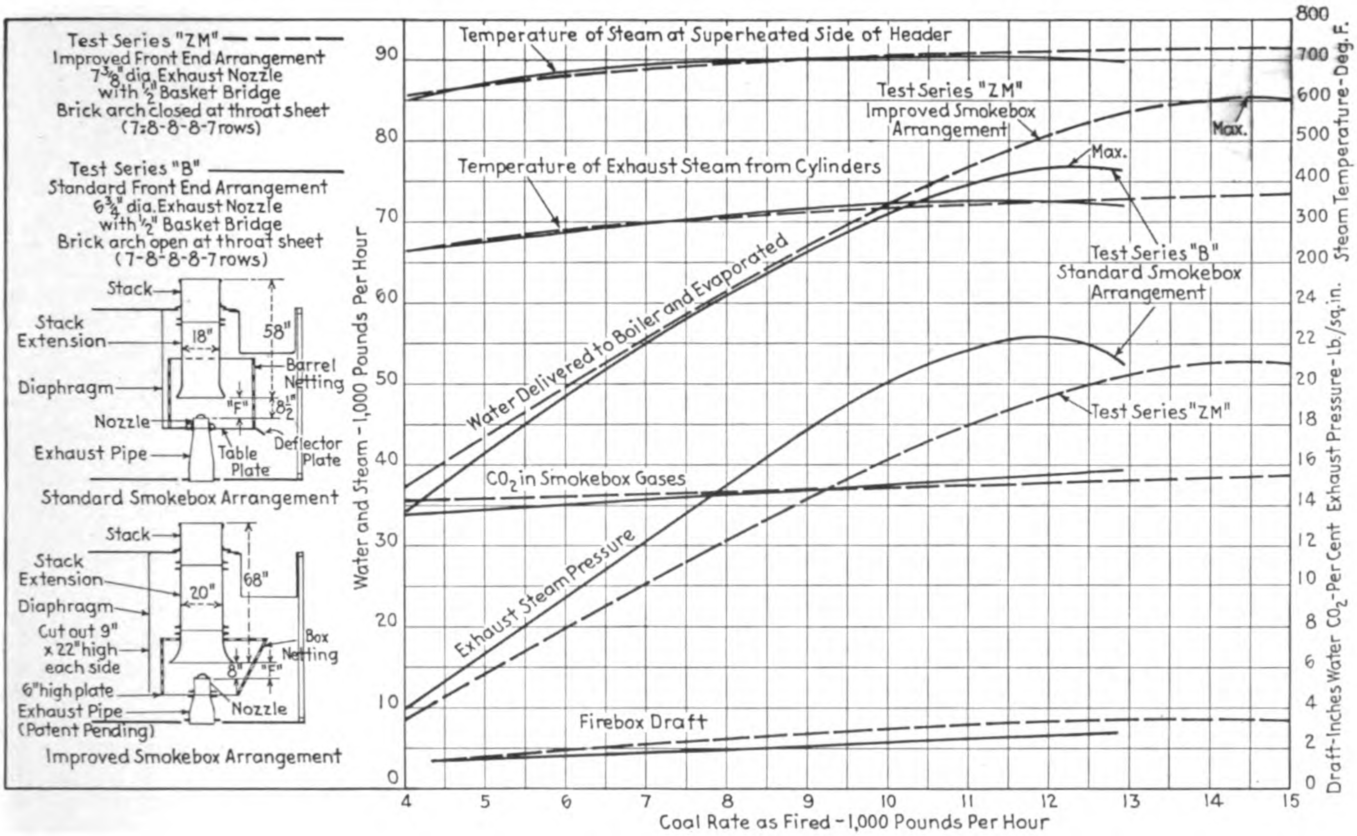
Average curves have been drawn showing the loss due to the unburned fuel and heat utilized in evaporation, but in order to show the losses due to incomplete combustion more clearly, the points affecting the heat lost in smokebox gases, radiation, and incomplete combustion have been connected by straight lines. Note the loss by unburned fuel and cinders, or so-called stack loss.

Rates of Evaporation

The summary of experiments with a conventional and an improved smokebox design is shown by the graphical representation of the test results in Fig. 12. The actual rate of evaporation is shown in relation to the rate of fuel fired for a New York Central Class J-1-b locomotive.

Sketches of the smokebox arrangements have been superimposed on these graphs as a matter of information. It will be noted that an appreciable increase in the evaporative capacity of the boiler has been obtained with a decrease in the exhaust pressure and both have been obtained principally by a change in the design of the smokebox arrangement. Some increase in performance is due to a closed-arch arrangement instead of an open-arch arrangement using toe bricks at the throat sheet.

The maximum firing rate is considered as the rate at



Locomotive Data

Cylinders, number, diameter and stroke, in.	2-25 x 28	Heating surfaces, sq. ft.:	
Driving wheels, diameter outside tires, in.	79	Tubes and flues	4,203
Boiler steam pressure, lb. per sq. in.	225	Firebox	281
Grate area, sq. ft.	81.5	Evaporative, total	4,484
Grate free air opening, per cent	22	Superheater	1,951
Fuel	Bit. coal	Combined evap. and superheater	6,435
		Volume of firebox, cu. ft.	410

Fig. 12—Summary of experiments with a conventional and an improved smokebox design in N. Y. C. Class J-1-B locomotive No. 5224

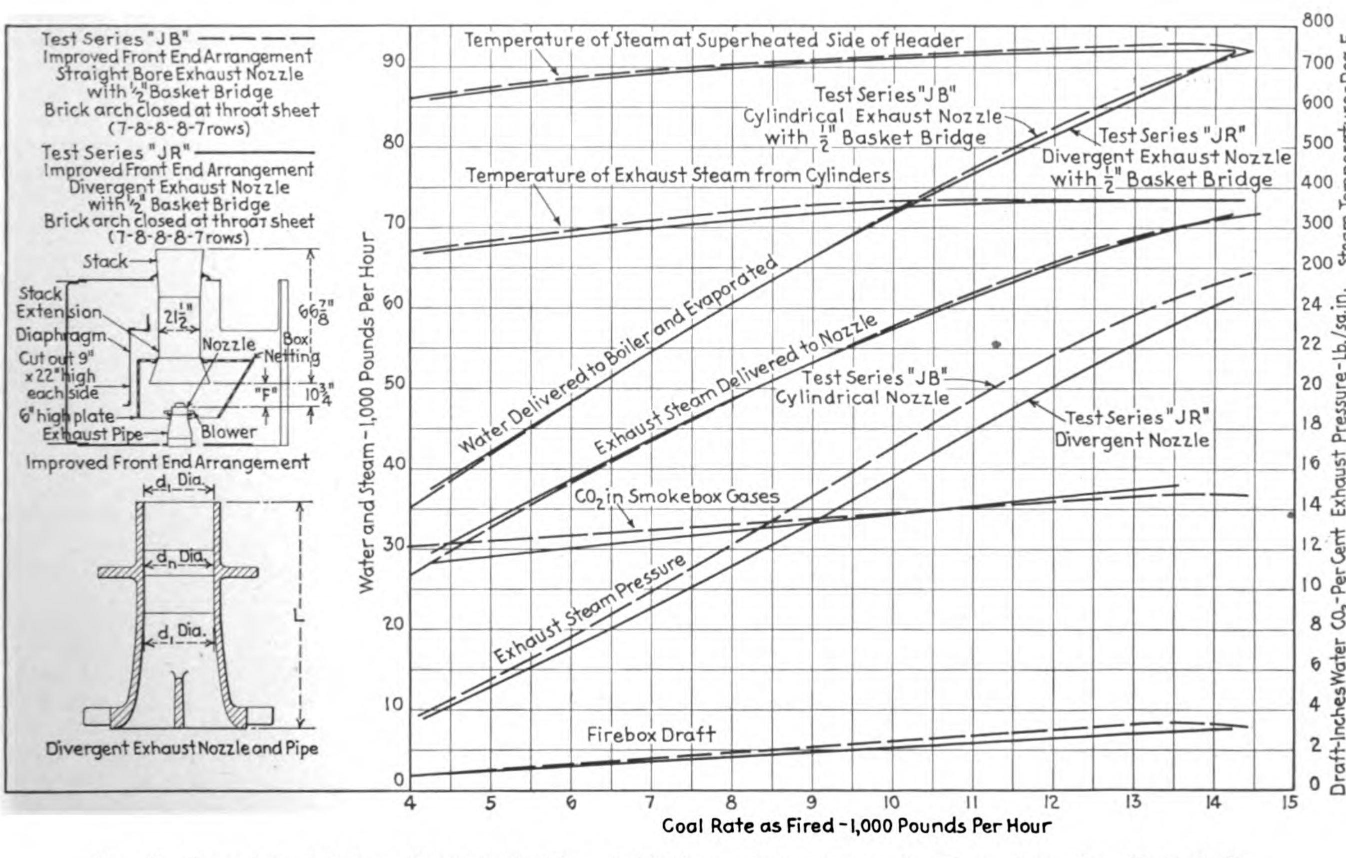
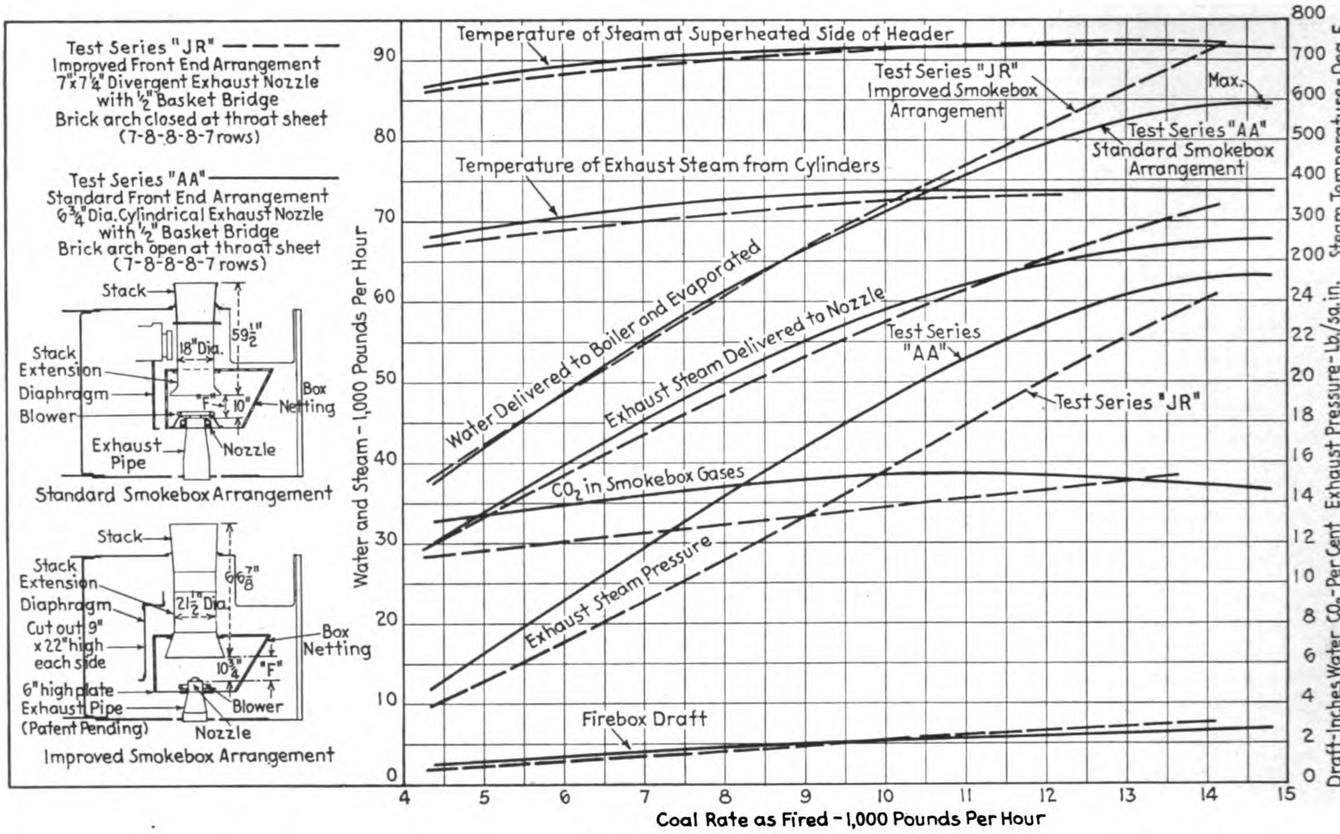


Fig. 13—Comparison of test results obtained with a straight-bore exhaust nozzle and a divergent nozzle in N. Y. C. Class J-3-A locomotive No. 5408



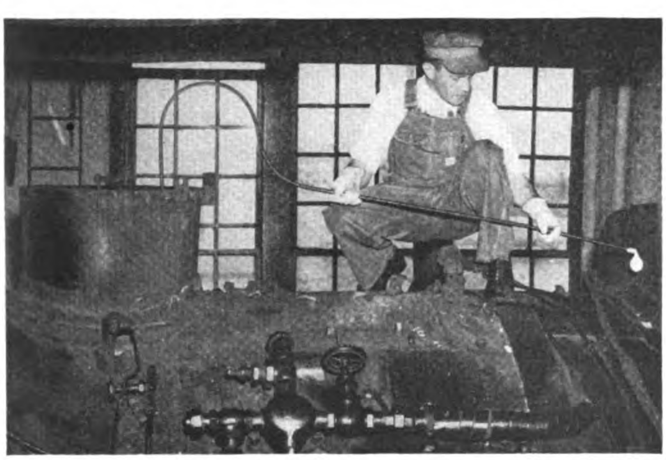
LOCOMOTIVE DATA

Cylinders, number, diameter and stroke, in.	2-22½ x 29	Heating surfaces, sq. ft.:	
Driving wheels, diameter outside tires, in.	79	Tubes and flues	3,827
Boiler steam pressure, lb. per sq. in.	275	Firebox and comb. chamber	360
Grate area, sq. ft.	82	Evaporative, total	4,187
Grate free air opening, per cent	25	Superheater	1,745
Fuel	Bit. coal	Combined evap. and superheater	5,932
		Volume of firebox and comb. chamber, cu. ft.	505

Fig. 14—Preliminary results of improved and standard front-end arrangements in New York Central Class J-3-A locomotive No. 5408

which maximum evaporation has been or can be reached. It is possible to increase the firing rate beyond this point, but the increasing heat losses due to unburned fuel and incomplete combustion offset the heat required to evaporate the additional water. This point is indicated on the graph by an arrow.

Fig. 13 shows graphically the test results with the use of the divergent nozzle as compared with the use of a straight side circular nozzle. The sketch superimposed on the graph shows the Class J-3 locomotive improved front-end arrangement and the divergent nozzle. The rate of evaporation has been maintained with an appreciable decrease in exhaust pressure.



The exploring tube being used by a test observer

Preliminary results of the J-3 locomotive tests are shown graphically in Fig. 14. The actual rate of evaporation is shown in relation to the rate of fuel fired. It will be noted that the maximum rate of evaporation, as defined above, has not been reached for the *JR* series with the improved smokebox arrangement and divergent nozzle. An appreciable increase in evaporation at the upper firing rates has been obtained with a decrease in exhaust pressure.

Conclusions

The design presented in Figs. 12 and 14 show a smokebox arrangement whereby the stack has been lengthened and the resistance to the flow of gases has not been increased. The table plate has been lowered 10 in. and the diaphragm has been cut away at the sides adjacent to the smokebox shell an amount equal to the area taken away by lowering the table plate. These cut-outs are not very large and, therefore, the remaining portion of the diaphragm will be sufficiently large in area to function as an impinging surface for the cinders instead of having them strike directly on the netting of the box-type spark arrester.

The cut-outs in the diaphragm also shorten the path of the gases coming from the flues above the bottom of the diaphragm by permitting the gases to pass directly to the stack with two right-angle turns, or 180 deg., instead of five right-angle turns, or 450 deg., as in the usual tortuous route of the conventional design. This particular design represents an increase in efficiency resulting from the improvement in the design of the smokebox arrangement by systematic experimentation with mathematical calculations and theoretical principles entering where they may be useful.

American Car and Foundry Develops New Design of

Covered Hopper Car

Car for loading of bulk commodities has maximum cubic capacity of 2,040 cu. ft. with light weight of 48,100 lb.

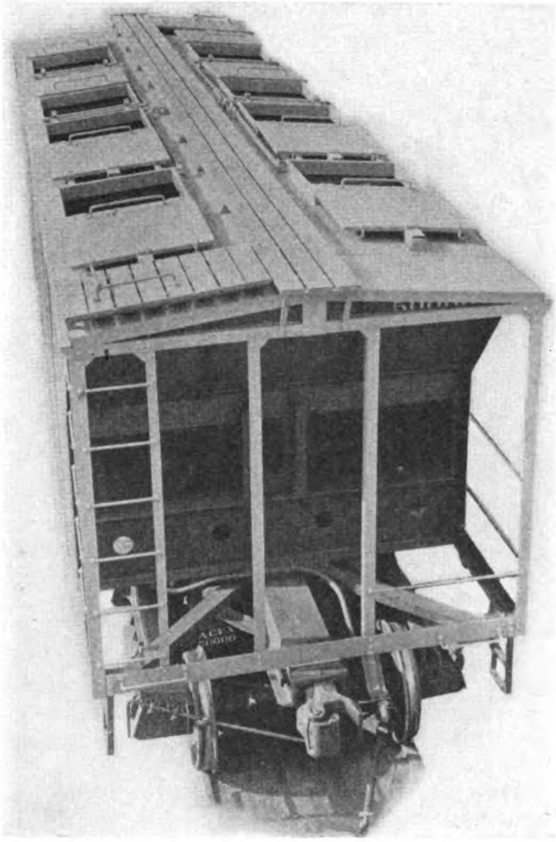
AFTER an extensive study of covered hopper-car designs with a view to producing a car having greater earning capacity than existing designs the American Car and Foundry Company has built a demonstration car acfx No. 50000 developed expressly for the handling of such bulk commodities as cement, clay, lime, powdered coal, dolomite, glass sand, etc. This new car has a light weight of 48,100 lb. and a nominal capacity of 140,000 lb. The body of the car weighs 29,640 lb. and the trucks 18,460 lb. By comparison with this car the A. A. R. standard design of 70-ton hopper car weighs 30,640 lb. for the body and 18,250 lb. for the trucks, or a total of 48,890 lb. The cubic capacity of this covered hopper car, when loaded to the junction of the roof sheet with the side plate, is 2,040 cu. ft. If loaded only to the top of the horizontal side plate web, the capacity is 1,981 cu. ft.

Cement, as it is blown into the car at the loading position, weighs about 80 lb. per cu. ft. because of the air trapped in it. During the loading operation, a portion of this air will escape as the cement settles and before the car has travelled very far a sufficient portion of this air will have escaped and the cement settled so that it has a density of from 92 to 96 lb. per cu. ft. This car has sufficient cubic capacity to permit loading to the full revenue load limit of 161,900 lb., or nearly 81 tons. As compared with the largest covered hopper car previously built by the American Car and Foundry Company for cement transportation, this car has an increased capacity of 82 cu. ft. when figured to the junction of the roof sheet and the side plate and 89 cu. ft. to the top of the horizontal web of the side plate. On the other hand, its light weight is 3,500 lb. less. The revenue load limit is thereby increased by a like amount or about 2.2 per cent. Compared with the previous car, the ratio of light weight to revenue load is changed from 3.07 to 3.36 and the percentage of revenue load to rail load limit from 75.5 to 77.1 per cent.

Structural Features

The center sill consists of A. A. R. rolled-steel Z-sections weighing 36.21 lb. per ft. with the top flanges welded along the center line of the car. The end sills consist of two 6-in. by 3½-in. angles extending from side sill to side sill and the side sills consist of two 6-in. by 3½-in. angles extending from end sill to end sill. The strikers are drop-forged and separate drop-forged draft lugs are welded to the center sill. The four diagonal braces are 5-in. by 3½-in. angles attached to the side and end sills and to the bolsters and center sills by means of gussets. The body bolsters are 24-in. by 9-in. car builder's sections extending from side sill to side sill across the top of the center sills to which they are welded and further connected by ⅜-in. gussets. The web of the bolster is riveted to the side stakes and the side sheet at the bolsters by means of 3½-in. by 3½-in. angle connections.

Demonstration covered hopper car built by the American Car and Foundry Company



End construction of the car and arrangement of the roof and hatches

The slope-sheet supports at the bolsters are $\frac{5}{16}$-in. bent plate extending the full width of the car and connected at the side of the car to the connection angles, previously mentioned, and near the center of the car by means of gussets to $4\frac{1}{8}$-in. Z-supports. The slope-sheet supports are connected to the bolsters by means of 5-in. by $3\frac{1}{2}$-in. angles which are separated by a 6-in. by 4-in. angle and extend longitudinally to connect the end floor-sheet stiffeners. The body side bearings are of hardened

Principal Weights and Dimensions of A. C. F. 70-Ton Covered Hopper Cars

Length over strikers, ft.-in.	35- 3
Length inside, ft.-in.	29- 3
Length, center to center of trucks, ft.-in.	25- 3
Width over side plates, ft.-in.	10- 5
Width inside, ft.-in.	10- 0
Height, over running boards, ft.-in.	12-10¼
Height to top of side plates, ft.-in.	11-10
Capacity (top of side plate horizontal web) cu. ft.	1,981
Capacity (junction of roof with side plate) cu. ft.	2,040
Light weight, lb.	48,100
Load limit, lb.	161,900
Ratio light weight to revenue load, per cent	3.36
Ratio revenue load to gross weight, per cent	77.1
Hopper centers, ft.-in.	11.9

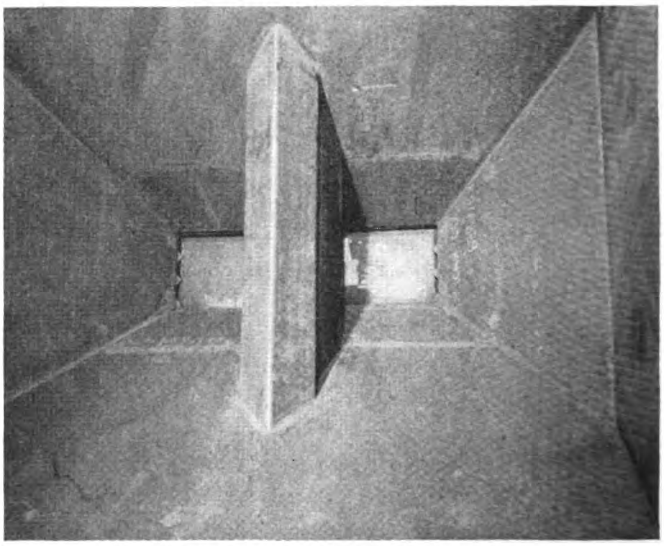
steel and the side-bearing members consist of an 8-in. I-beam welded to the bolster and the center sill flanges by means of angles. The body center plates are drop forged.

The slope sheets are $\frac{1}{4}$-in. plate extending from side to side and from carline angle to a point slightly below the sills where they are welded to the slope-sheet extension which continues to the discharge gates. The slope sheets are welded to the side sheets, outside hopper sheets, discharge gates, inside hopper sheets and longitudinal hoods.

The center partition is $\frac{1}{4}$-in. plate extending from side sheet to side sheet and from the underside of the roof at the center carline to a point approximately 15 in. below the joint of the cross-ridge floor slope sheets. The cross ridge slope sheets are $\frac{1}{4}$-in. plate extending from side to side. They are in two sections welded together at a point slightly below the center sill. The cross-ridge sheets are welded to the partition sheet at the top as well as to the side sheets, outside hopper sheets, inside hopper sheets, discharge gates and longitudinal hoods. The outside and inside hopper sheets for the four hoppers are of $\frac{1}{4}$-in. plate with welded connections to the side and slope sheets, longitudinal hoods and discharge gates. The longitudinal hoods are $\frac{1}{4}$-in. plate extending between the floor slope sheets over the center sills and are welded at the connections. The discharge gates are of the sliding type, manually operated. They move lengthwise of the car and are arranged to permit full or partial openings.

The side sheets on these cars are No. 7 gage open-hearth steel butt welded to each other and welded to the slope and hopper sheets, as previously described. The side plates are of 3-in. Z-bar extending the full length of the car with $1\frac{3}{4}$-in. by $1\frac{3}{4}$-in. sub side-plate angles. The intermediate side stakes are $\frac{1}{4}$-in. pressed plate with $\frac{3}{8}$-in. pressed stakes at the bolsters, extending from the side sills to the side plates. All of the side stakes are welded to the side sheets. The corner posts are $3\frac{1}{2}$-in. by $3\frac{1}{2}$-in. angles and the end posts are 3-in. by 3-in. angles.

The roof construction consists of 11 carlines of 3-in. by 3-in. angles formed to suit the contour of the roof sheets which are of No. 11 U. S. gage steel riveted to the carlines. There are eight hatches, four on each side,



Welded construction of the car provides smooth interior surfaces

of $\frac{3}{16}$-in. open-hearth steel with longitudinally sliding covers of No. 11 U. S. gage steel. The locking arrangement for the hatch covers is arranged so that one man standing on the running board of the car can lock or unlock all eight hatch doors by throwing one lever. After the doors are unlocked, it is necessary only to raise the front end of the door slightly so that a lip on the door will pass over the top of the hatch frame and the door may be slid back to the full open position.

Upon the completion of acfx No. 50000, the car was subjected to a series of impact tests by loading to practically full rail load limit with wet sand. The total weight on the rail was 209,800 lb. The test car was used as a striking car and the car which was struck was a heavy steel car loaded to full rail limit of 209,820 lb. Eight

impact tests were made at speeds of from 5½ to 12 m. p. h. The test results evidenced the ability of the car structure to withstand the stresses imposed.

Trucks and Brake Equipment

These cars are carried on four-wheel trucks with cast-steel double-truss type side frames having boxes cast integral. The bolsters are cast steel with integral center plates. The trucks are equipped with A. A. R. 33-in. diameter chilled wheels and 6-in. by 11-in. A. A. R. standard axles. The truck wheelbase is 5 in. by 8 in. The brake equipment is the latest AB schedule with 10-in. brake cylinders.

Dust-Deflecting Fans on National Journal Boxes

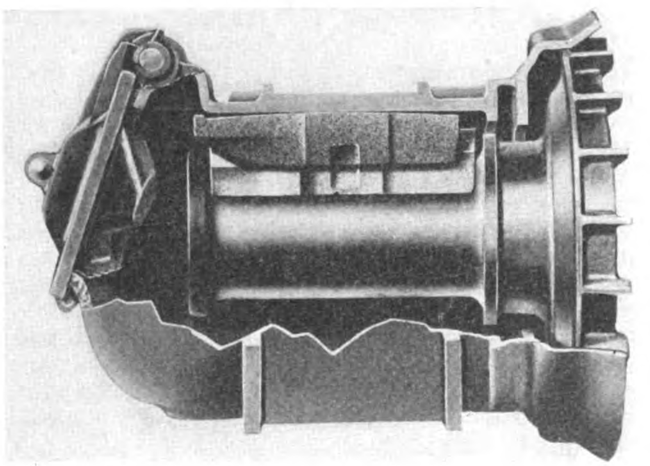
The National Malleable and Steel Castings Company, Cleveland, Ohio, has redesigned both its Isothermos and waste-packed journal boxes to include the application of a dust- and dirt-excluding fan in place of the standard dust guard. An additional feature has been incorporated with the fan in both applications. An oil-retaining ring is an integral part of the fan for the Isothermos box while included with the fan for the waste-packed box is a thrust ring that doubles the thrust area against the journal bearing over that in the present A. A. R. axle.

The Isothermos journal box is designed to meet modern railroad transportation requirements of heavier axle loads and higher speeds with reduced maintenance expense. They may be applied with A. A. R. standard axles to various types of trucks including the wide pedestal design generally used with roller-bearing boxes. When applied new, or when wheel renewals are made, the equipment may be operated immediately in high-speed service as special breaking-in is not required.

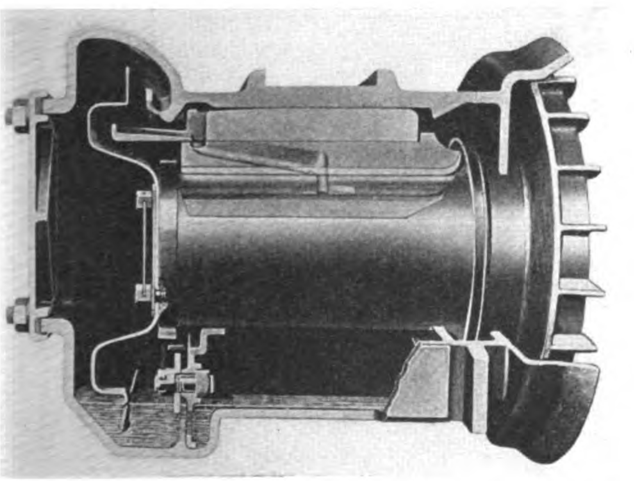
This journal box furnishes lubrication comparable to an oil bath, without the use of auxiliary parts that may be subject to wear. The box is properly lubricated by the use of an all-year grade of oil. It is not necessary to change oil or to add thinning oil en route to protect against temperature changes. Seasonal oils are recommended only when temperatures are lower than 40 deg. below zero or when the boxes are installed on extra heavy equipment. Depending on the size, the box has an oil capacity of from five to eight pints. This is about the same amount of oil as is required for saturization in a waste-packed box. The oil circulation is approximately one pint per mile.

One illustration shows the Isothermos journal-box assembly applied with an A. A. R. standard axle. The dipper, attached to the end of the axle, carries the oil from the bottom of the box upward to the oil tray cast on the outer end of the wedge. At low speeds, the oil is dropped on the tray and at high speeds the oil is thrown to the top of the box from where it drains to the oil troughs cast in the box and then drops on the oil tray. From the oil tray, the oil passes through grooves in the bearings and is spread over the length of the journal. The grooves in the journal side of the bearing have a wedge-shaped space that retains a small amount of oil in contact with the journal when the equipment is standing. The oil remains in this space indefinitely and immediately lubricates the bearing when any movement of the equipment takes place. A baffle retaining block is applied at the front end under the journal after the bearing and wedge are in proper position. This block restricts the vertical movement of the box with respect to the journal and prevents displacement of the wedge or bearing when operation is over rough track.

The oil-retaining ring and dirt-excluding fan is shrunk on the axle between the journal fillet and the wheel seat. The oil-retaining ring is located adjacent to the journal



The National waste-packed journal box with the dust-deflecting fan shrunk on the axle—The thrust ring produces a 100 per cent increase in thrust area as compared with the present A.A.R. axle



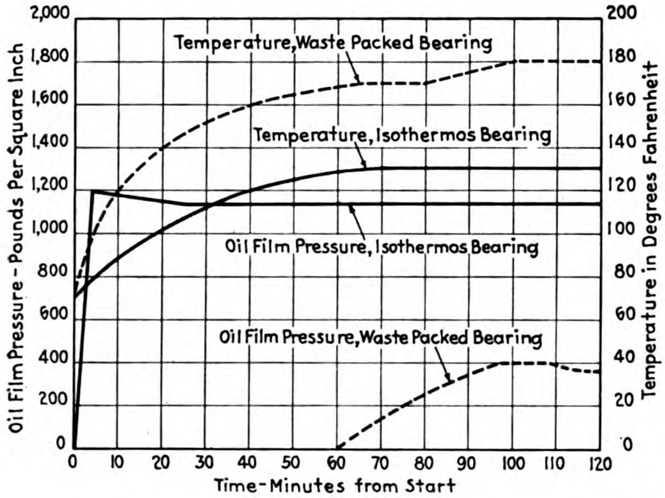
The National Isothermos journal-box assembly produces lubrication comparable to an oil bath and uses an all-year grade of oil—The dust-deflecting fan and the oil-retaining ring are shown at the right

fillet while the projecting fan blades extend over the wheel hub. The fan blades are shielded by a circular hood located at the back end of the journal box. As the fan revolves with the axle inside this housing, the blades create a violent air turbulence thus preventing the entrance of foreign matter into the box.

A special design of these boxes is available for service in freight cars that are handled over car-dumping machines. Cavities located in the sides of the box retain the oil while the box is on end during the dumping operation.

Among the outstanding records of Isothermos journal-box installations is that of two million locomotive tender miles under maximum wheel and tender loading without a hot box. These tenders operate in a climate where the temperate range varies from 100 deg. above to 35 deg. below zero and use only an all-year oil.

Six high-speed Diesel-electric locomotives equipped with these boxes have operated more than 3,441,900 locomotive miles. These locomotives have an average avail-



Typical oil film pressure and temperature curves for waste-packed and Isothermos journal bearings

ability of 95.5 per cent and one of them has had an availability of 99.3 per cent for 515,485 miles of service.

Under a freight car operating exclusively in service that requires the car to be unloaded on a car-dumping machine, journal boxes of the special car-dumping type have given six years of satisfactory service. The boxes were sealed and no lubrication attention was given them between annual inspections. This car operates more than 12,000 miles each year.

The data shown graphically in the chart were obtained from tests made on the National journal-box testing machine. The load on the 5½-in. by 10-in. journal was 20,000 lb. The speed was equivalent to 60 m. p. h. and the bearings were well broken in. Oil film pressures were measured at the center of the bearings by means of a high-pressure gage and temperatures were measured at the sides and near the rear of the bearings.

A comparison of the curves shows that the Isothermos box had a stable oil film pressure from the start of the test while the waste-packed box bearing operated 60 min. before the oil-film pressure started to build up. At no time during the 120 min. operation was the oil-film pressure in the waste-packed box sufficient to carry the load completely.

The dust-deflecting and thrust-ring fan applied to the National waste-packed journal box is shown in one of the illustrations. Except for the housing around the fan, all essential parts of the box conform to A. A. R. standards. As a protection against end wear and failures at the wedge stop lug, a 100 per cent increase in thrust area, over that in the present A. A. R. axle, is obtained by the thrust-ring part of the fan. The wheels can be turned without removing the fan from the axle and the box can be jacked for the removal of the wedge and bearing in the usual manner. For existing boxes, fan housings can be furnished separately for application by welding.

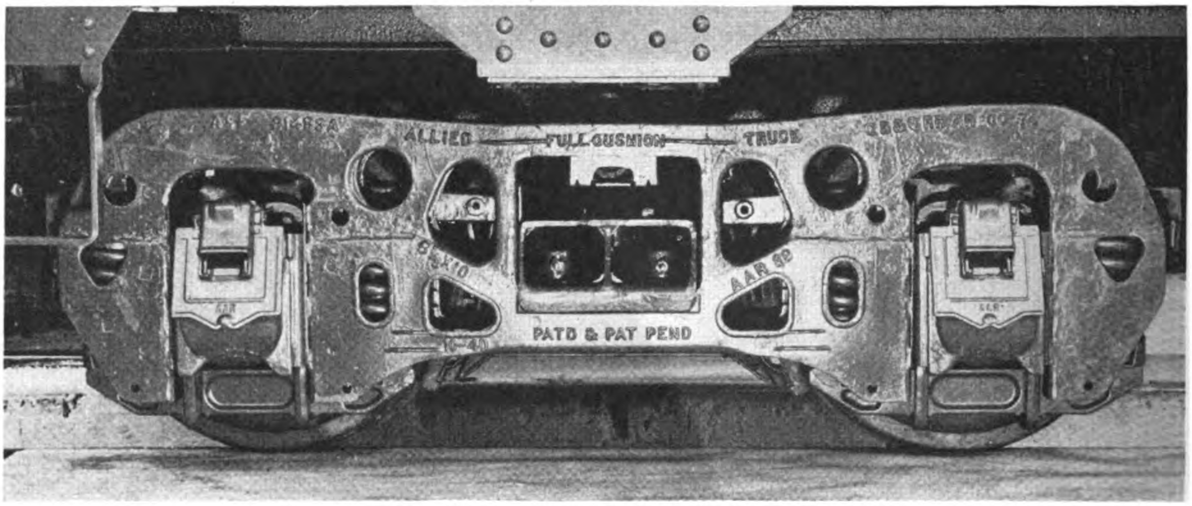
The National waste-packed journal box has the Flexo A. A. R. lid using a double coil spring of large diameter and moderate wire size. This spring produces sufficient pressure at the center of the lid to hold it tight against the face of the box regardless of the condition of the hinge lug. Serrations are cast on the inner face of the lid where it contacts the box. In service, these wear slightly into the box face or into high spots and help to make more efficient the oil- and dust-tight joint between the lid and box faces.

Full Cushion Truck

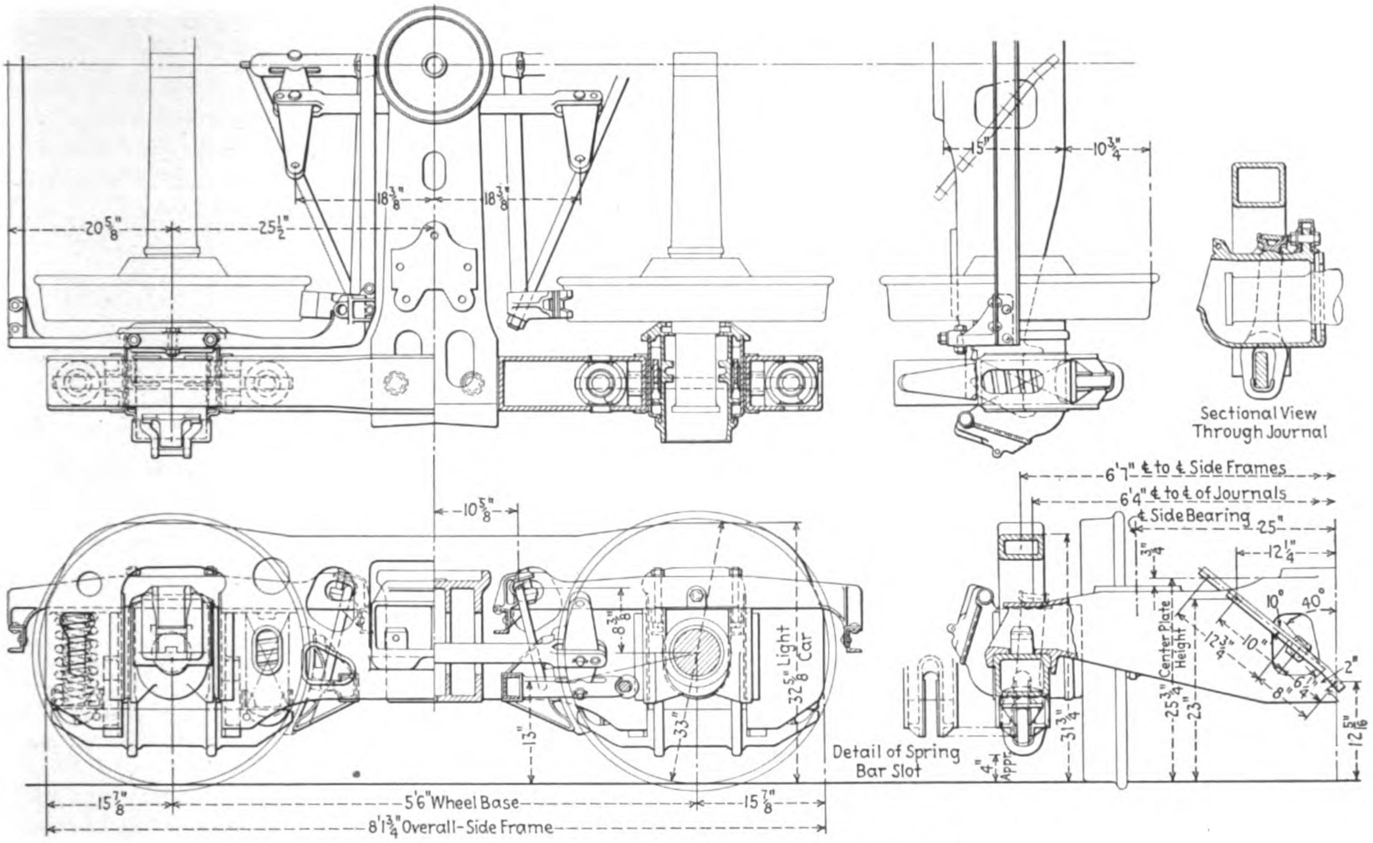
The Allied Railway Equipment Company, Chicago, is offering a new high-speed freight-car truck of novel design which has shown favorable results in both test and regular service. Known as the "Full Cushion" truck, it is a cast-steel development of the truck of that name included in the Association of American Railroad tests last year at Altoona, Pa. The side frames and bolsters are designed to comply fully with all A. A. R. specifications for material and for test requirements.

The truck provides long vertical spring deflection. It is also designed for lateral stability by limiting to the wheels and journal boxes all the lateral reactions from the wheels. This lateral control also eliminates the usual unsquaring forces of a rigid type of truck. Vertical and lateral shocks at all car speeds are said to be absorbed in the truck itself, therefore not being transmitted to the car body or its lading.

The Full-Cushion truck differs from other freight trucks in that, with the bolster resting directly on the side frames and automatically locked in position an H-shape rigid assembly serves as the main member of the truck. The separate journal boxes can move vertically



The Full Cushion high-speed freight-car truck



General arrangement of the Full Cushion freight-car truck

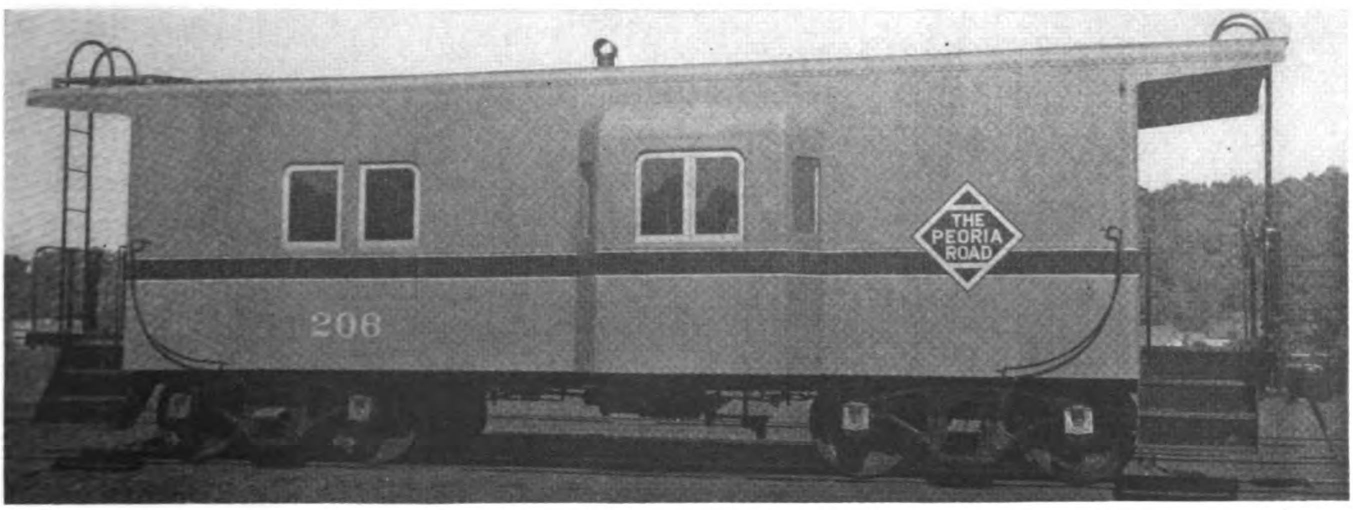
and also laterally in the pedestal openings of the side frames. The boxes for each pair of wheels are connected rigidly together by a rectangular frame that spans the wheels and, therefore, move laterally as a unit, the vertical movements being independent. This frame provides a support for the usual brake beam and connections and is suitable also for the use of clasp brakes when desired.

Springing is accomplished by the use of two long double-coil springs of large diameter, one at each side of each journal box, housed in space in the side frame adjacent to the pedestal guide. The springs when in position rest on seat castings which engage a spring-supporting bar extending across the pedestal openings below the journal box and between guides at the lower end of the pedestal jaw.

The spring load is transmitted to the journal box from the spring-support bar through an inverted U-shape hanger which straddles the box and projects below it. The enlarged ends of this hanger are designed with elongated holes or slots, through which the spring-support bar may be readily inserted. These journal-box hangers can swing laterally of the truck about the bearing point on top of the boxes, their neutral position being with the lower ends angled outward. Provision is made, by means of safety stops on the journal box contacting the side frame, for generous lateral motion of the wheels, axles and journal boxes independent of the truck bolster.

The assembly of the truck and the relative movement of the main framing and the wheel and box assemblies are shown in the drawing.

* * *



One of six cabooses recently built by the Toledo, Peoria & Western

EDITORIALS

Safety—A Real Asset

While the railroads can well afford to take pride in their accomplishments in reducing accidents to both their employees and to the passengers, the record is still far from satisfactory. With increasing traffic and the greater number of employees required, the accident rate is again creeping up.

Leaving humanitarian considerations aside for the moment, the economic effects of accidents are very great, when loss and damage to material and equipment and interruptions to service are considered. When, however, this is supplemented by the distressing effects upon the morale of the organization and the suffering of the worker and his dependents, it would seem that almost any effort would be warranted to reduce the number of accidents to a minimum.

A study of the awards made to railroads by the National Safety Council and of the E. H. Harriman Memorial Medal awards under the direction of the American Museum of Safety, indicates that some roads consistently maintain much better safety records than others. This does not just happen. There must be sound reason for it. Is it not primarily a matter of intensive education and of a positive policy on the part of the managements to secure and maintain the greatest possible safety? The entire organization must be made to feel "safety conscious." This does cost time and money, but it does insure results, tangible and otherwise, that many industrialists believe much more than offset such expenditures.

Sabotage

It is easy to grow hysterical as one understands some of the terrible things that are happening in world affairs today, and even within the boundaries of our own favored land. On the other hand, there is danger that these long continued recitals may cause us to grow careless and indifferent and that we may not be awake to sabotaging in our own communities. The most dangerous criminal or operator may not, and quite likely does not look the part. Too often his methods are so well veiled that we have difficulty in recognizing them, with the result that we find our morale being undermined and production slowed up—something far more dangerous and damaging than the breaking of a machine or the turning out of a spoiled piece of work or equipment. It is a time when we must not become jittery or do sloppy thinking. We must keep level heads on our shoulders and, without prejudice or bias, watch things closely to prevent serious damage being done, whether to materials or equipment, or in sapping our morale.

What Kind of Cars?

One of the interesting aspects of the national defense program is the change it is effecting in the relative volume of various commodities and in the acuteness of the demand for freight cars of various types in various territories. These changes are one of the difficulties in the way of every attempt to forecast the probable trend in the demand for freight cars during the current year.

This situation was touched upon by C. H. Buford, vice-president, operations and maintenance department of the A. A. R., speaking, early in January, before a luncheon in Chicago sponsored by the Mid-West Shippers Advisory Board and the Public Affairs Committee of the Traffic Club of Chicago. With all these uncertainties, however, he expects the emergency traffic to provide a continuous, all-year loading which "will fit in with the usual pattern of commercial traffic to provide a more complete year-around utilization of equipment.

Already there are evidences that such is the case, at least so far as certain types of equipment are concerned. Last year there were a number of recurring pinches in Michigan affecting automobile box cars with end doors and to a lesser extent box cars in the west. Prompt action on the part of the Car Service Division and the willingness of the railways to cooperate in carrying out its special orders have so far been effectively meeting these situations as they arise.

Trend in Number of Freight Cars of Principal Types* Ordered

	1939	1940	First six weeks 1941
Box	20,170	31,069	6,923
Auto-box	559	3,178	525
Gondolas	5,859	7,979	4,520
Gondolas, Mill type	350	415	625
Hopper	20,884	12,230	1,405
Hopper, covered	557	1,896	185
Ore	1,749	222	200
Ballast	534	1,954	250
Flat	977	932	572
Stock	100	338	300
Tank	2,277	1,623	....
Refrigerator	675	1,285	1,035

* A few types of cars for industrial use, ordered in small numbers, have been omitted.

One of the indirect evidences of the changing traffic

pattern is the sharp upward trend in orders for certain types of freight cars, most of them specialized for specific kinds of lading. In 1940, for instance, orders for automobile box cars and covered hopper cars increased in much greater proportion than did the total number of cars ordered. And during the first six weeks of the current year there have been similar striking proportionate increases in the orders for stock cars, mill type gondolas, refrigerator cars, all other gondolas, and flat cars. These relationships may be seen in the table of freight-car orders placed during 1939, 1940, and during the first six weeks of the current year. While the proportionate increase in these types is striking, the fact that they are usually ordered in relatively small numbers must be considered, and while the increase in the proportion of box-car orders is slight, the number is large—nearly 7,000 during the first six weeks of the year.

Now—And After . . . .

The machine tool industry of this country, during the years 1931-34 produced an average of 30 million dollars worth of new tools a year; in 1939 production was at the rate of 200 million dollars—greater than it was in 1929. In 1940 that production was more than doubled—450 million dollars—and in 1941 it is expected that the output will exceed 650 million dollars. These new tools have been and are now going into the industrial plants of the United States and other countries—mostly England—and are installed primarily to speed up work on defense contracts.

It has been suggested that when the war is ended and the nations of the world once again return to peacetime industrial efforts that the manufacturers of the United States may find themselves in a difficult situation as a result of intense competition in export trade aggravated by lower labor costs in other countries plus the fact that their plants are equipped with modern machinery built and sold by this country during the war period.

Many industrial executives in this country are farsighted enough to protect the interests of their own companies by using this period to put into effect a systematic program of replacement of the older and more obsolete units by machine tools of the most modern design with the definite idea that once the pressure of war-contract work has ended they can then carry out a program of wholesale retirement of the less efficient units and have remaining a modern plant and equipment, well able to compete, on a production cost basis, with whatever may come.

Age of Railroad Tools Averages Over 20 Years

What are the railroads doing to protect their interests with respect to the cost of repairing equipment and what situation are they liable to face when the time comes that reduced traffic will again cause them to give primary consideration to economy in operation? Attention has been drawn on many occasions during the past few years to the fact that railroad repair shops do not compare very favorably with other industries in the matter of modern shop facilities. In 1934 surveys disclosed that the average age of machine tools in the average railroad repair shop was over 20 years and it has been suggested that the railroad industry needed a carefully planned program of replacement of obsolete equipment in order to maintain an average age even of 20 years. Now, seven years later, it is not unreasonable to assume that, with the limited buying of the intervening period, the average age of tools is climbing to higher levels.

Recent surveys have indicated that 82 per cent of the machine-tool equipment of railroad repair shops is over 10 years old. Stated in other terms only 18 per cent of such equipment can be considered as modern equipment. A very large part of the machine tools that have been purchased in the past 10 years are of types especially adapted to railroad work such as driving- and car-wheel lathes, quartering machines, milling machines for special purposes such as driving boxes and shoes and wedges, vertical boring and turning machines with special tooling, turret lathes with tooling equipment for relatively small diameter bar and chucking work, grinding machines for specialized work, and welding equipment for both car and locomotive work.

New Tool Steels Have Taught a Lesson

Within the past five years a great deal of attention has been given in railroad shops to the use of the more recently developed tool steels in the high-speed and cemented-carbide class. The introduction of these newer cutting tools has been an enlightening venture in every shop where they have been used for they have shown possibilities for increased production and greater accuracy that were never before considered attainable. They have been used on most of the important machining operations involved in locomotive work—on brass, bronze, cast iron, gun iron and steel—and in addition to reducing operation time and providing finer finished surfaces they have demonstrated the ability of a tool to turn out quantities of work without tool regrinding that would have been considered an absolute impossibility only a few years ago. Still more important, these new tools have done something with respect to the older machine tools that should have been brought to light long ago; they have demonstrated the inability of the older machines to stand up to production schedules that are required today. The new tools have the ability to work at higher cutting speeds and heavier feeds but the older machines haven't the power, and in many cases the rigidity, to enable them to work at the increased capacity. The new tools have the ability to turn out work to standards of accuracy not heretofore attainable but most of the older machines are not in the physical condition to do this kind of work under the newer conditions. So, again the conclusion can be

drawn that most railroad shops are paying a rather heavy price for maintaining old machines in service.

Can Railroad Shops Work on Defense Orders?

Recently it was announced that the A. A. R. had made a survey of idle railroad shop facilities with the idea of using such facilities to supplement industrial plant production on national defense contracts. There is every reason why every idle production facility in this country be used in the re-armament effort but the suggestion to use the "excess" capacity of railroad shops raises some pertinent questions. When national defense contract orders are placed with a railroad shop are these jobs going to be assigned to the machines that are in the group representing the 18 per cent, or machines less than 10 years old or are they going to be put on the 82-per-cent group of 20-, 30- and 40-year-old machines? The 18-per-cent group will probably be found to be mostly specialized machines adapted only to special machining operations and it may also be found that there is now no idle capacity represented in this group of the more modern machines. The idle capacity will probably be found to exist on the oldest of the group of machines in any shop that are over 20 years old.

It is not, of course, possible at this moment to indicate just the type of defense contract work for which it is proposed to use this idle railroad shop capacity so that for purposes of discussion one example may be just as good as another. Let's use 75- or 90-mm. shell. An average railroad shop gets an order for the machining of shell forgings. On looking the shop over we find that of the major machine tools in the 10-year, or-over group, there are approximately 150 units varying in age from 12 to 41 years. Of these, 41 are engine lathes, 18 are turret lathes and 16 are boring mills. The rest are milling machines, drilling machines, planers or wheel or axle machinery. Among the turning and boring machines are the units that might be used for finishing shell forgings. Suppose, for example that the job is put on an engine lathe—the average railroad shop turret lathe is not of sufficient capacity to do this type of work—and an estimate is made of the time required to finish a shell of these types. The estimator will no doubt be shocked to discover that the production would be at the rate of *one* or *two* pieces an hour as compared with from *30* to *60* an hour on modern shell-turning automatics. At such a production rate, and cost, it is doubtful if the idle capacity of railroad shop machines can contribute a great deal to the defense effort unless an unforeseen demand for motive power should come under actual war-time conditions. Then, regardless of the cost, the productive capacity could be used—if the skilled workmen can be found to use it.

The conclusion to be drawn from a consideration of these facts is that the railroads owe it to themselves to find out immediately just what their situation is with respect to the adequacy of repair shop facilities. It is already too late to embark on any immediate extensive program of plant rehabilitation but it is not too late to know what is needed to put repair shops in a position to do their job economically. Now is the time to find out how much the obsolete machine is holding up production and running up costs and until this is found out no intelligent move can be made to improve conditions.

Possibly the government defense agencies might do the railroads a real favor by giving them a few educational orders so that they might discover how inadequate their present shop facilities are for modern production requirements.

Mechanical Conventions

Again our readers, widely scattered and members of the several mechanical associations, have come through with a page of comments on how to strengthen these associations and make their conventions more effective. Quite naturally these comments are not all in agreement, although the differences of opinion are not very decided. Certainly there is much that is really workable and worth while in the comments made in this and the two preceding issues. Judging from reports that have reached us, the officers of the associations and chairmen of the committees, are taking advantage of some of those ideas that apply with special force to their particular associations. We appreciate the cooperation that has been given us in conducting this forum and will be glad to continue it with your cooperation.

New Books

PROCEEDINGS MASTER BOILER MAKERS' ASSOCIATION, 1940 ANNUAL MEETING. *A. F. Stiglmeier, secretary-treasurer, 29 Parkwood street, Albany, N. Y. 290 pages, 5½ in. by 9 in. Price $3.*

In the 1940 proceedings are Topics 1 to 8, inclusive—Use of Oxy-acetylene and Electric Processes; Causes for Pitting and Corrosion of Firebox Sheets and Rivet Heads; Treating Boiler Feedwater Chemically; Application of Iron, Steel and Alloy Rivets; Causes for Flues in Service Cracking Longitudinally Through Bead; Causes for Cinder Cutting of Firebox Sheets, Flues, Tubes and Smokeboxes, and A Study of Tender Cistern Maintenance Practices. There are also the addresses by Dr. Edward C. Elliott, on Some Neglected High Pressures; M. A. Quinn, on The Boiler Maker—His Accomplishments, Opportunities and Ambitions, and A. G. Trumbull, on Some Problems of Boiler Maintenance, Past and Present. There are papers on Welding Stresses, Use of Oxy-acetylene Cutting and Welding in the Boiler Shop, and Service Aging of Firebox Materials.

Suggestions for Mechanical Associations

As to Type of Reports

Discussions are longest on items that are most interesting. If a paper is read that is highly technical, or one that everyone feels he knows all there is to know about, which sometimes happens, there is very little or no discussion. These types of papers can and should be eliminated. With a two-day meeting we should also cut down on the number of speakers reading prepared speeches.

Eliminate Foolish Questions

When conventions are held without exhibits I am in favor of the curtailed meetings, and if handled right I believe two days is ample time for discussion purposes. If this plan can be worked out, and I can see no reason why it cannot, the committees should have their papers sent in far enough in advance so the secretary of the association can get copies out to all those indicating they will attend the convention. This would eliminate some of the foolish questions brought up in the discussions.

Conventions Too Formal?

Conventions of the minor mechanical associations are too formal. They are conducted much like a supreme court hearing. Less formality and more whole-hearted, common-sense, everyday discussion would materially improve the advantages gained by attendance. A two-day convention is a short time, even with proper planning. The contacts and friendships that can be followed up to advantage between conventions are not made on the floor of the convention, but instead, are made in those small informal groups that gather before and after the formal sessions. However, eliminating the general addresses, and devoting the time thus gained to a well participated in informal discussion on the floor, will to a great extent assist in promoting friendships.

Papers and Reports Too Wordy

Generally speaking, I believe the papers presented before conventions are too lengthy. Frequently the person compiling a paper is comparable to an author writing a book, and employs a great many words which to the average busy man are nonessential in a technical paper. In order for one to digest the essential points which are really worthwhile and mean something definite to the supervisor or foreman, one should not require him to read through or listen to unnecessary detail. In other words, while sitting in a convention listening to the average lengthy paper, possibly six to twelve notes on the part of the hearer would cover the essential parts of the entire address or paper. If a person is requested to write a paper and he has something of interest to impart to the convention, he should do so in the briefest manner. I feel quite sure that if all papers and discussions were streamlined, more could be accomplished during a two-day meeting than would be accomplished during a four-day meeting, following the old practice of long drawn out discussions and lengthy papers.

Don't Waste Time In Reading Reports

The most interesting comment to me is that in which the question is asked, "Why not devote all the time of the meetings to debate and discussion . . .?" In many cases in past years, we of the Fuel and Traveling Engineers' Association have done just that, particularly when time was short. I recall that as chairman of the Committee on Preparation of Coal, on more than one occasion I referred very briefly to the written report, inasmuch as advance copies were available to each member, and I saw no reason for the long-drawn formality of reading the full report. I heartily agree with you, that if an advance copy of each report is in the hands of each member in sufficient time for proper study, written discussion can be prepared in advance of the meetings, and the time required for presentation of each subject greatly reduced, leaving sufficient time for proper verbal discussion. The reading of the reports should be restricted to a brief outline of the subject.

Distribute Reports in Advance

It is true that much time is needlessly taken by the chairman of each committee reading the reports in their entirety. Touching only the high spots and presenting the report for discussion will suffice. Distributing the reports in advance is essential to a successful convention. It will also make for a more thorough and intelligent discussion.

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Comments from readers on suggestions made in our November, 1940, number for making more effective the efforts of the Mechanical Department Associations. See also January number, page 25.

Questions by Mail

I believe you have taken a step in the right direction with your suggestion that copies of reports be distributed in advance thus allowing more of the time of the meeting for open forum purposes. In my opinion you could also add to that the privilege to those unable to attend the annual meetings of submitting questions by mail for discussion on the floor, which could be answered either by the secretary direct, or incorporated in the proceedings.

More Effective Committee Service

Each committee member must actively participate in the meetings and investigations of his committee so the report will consist of cross country opinion rather than that gained by the experience of only one or two committee members. Obviously the shortening of the time of the meetings makes it imperative that each committee devote more time to the preparation of its report.

"Step On the Gas"

A statement was made in your editorial relative to the cutting down on the length of conventions presenting a real challenge to the associations. It is my belief that this challenge can be met if the officers of the various organizations do not wait until the last six weeks before the convention to handle matters they could have handled several months previous. There is no doubt in my mind that the conventions can be made as interesting in two days as they have been in four. We must all admit that the conferences last year had a tendency to drag out, and when this happens a certain amount of the attendance is sure to be lost.

What a Railway Officer Wants From Conventions

When a railway official attends a convention it is with the expectation of bringing home new ideas. He is always on the lookout for some simpler, or cheaper method of handling the various maintenance or construction jobs which he has to take care of in his shop, or shops. Furthermore, he is always on the lookout for new machine tools of advanced design, which will cut labor costs and increase output. He is constantly looking for new hand tools, either electrically or pneumatically operated, which will enable an employee to increase his daily output with less fatigue. He is constantly on the alert for safer methods of performing work in order to avoid accidents to employees, with the resultant burden of compensation.

Rivet Cutting with The Hand Blowpipe*

Today, oxy-acetylene cutting blowpipes equipped with nozzles especially designed for rivet-cutting have made the removal of rivets a simple matter in salvaging steel plate. Procedures also are now widely standardized, making the rivet-cutting process extremely fast and economical. This is in direct contrast to former methods, by which the removal of rivets was slow and tedious, often resulting in damage to the plate and leading to considerable waste or reduction of the amount of metal salvaged for re-use.

Rivet-Cutting Principles

Although rivets can be removed readily with the standard cutting nozzle, the fastest and most economical method is to use a special low-velocity rivet-cutting nozzle. This type nozzle differs in appearance from the standard nozzle mainly in that the central cutting-oxygen orifice is larger.

In practice, the preheat flames are directed against the center of the rivet head, bringing the metal quickly to its kindling temperature. The cutting-oxygen valve of the blow-pipe is then opened, releasing a stream of low-velocity oxygen through the central orifice of the nozzle. This jet of oxygen rapidly oxidizes the heated rivet head so that the metal "washes" away in the form of hot slag. The adjacent plate is not affected because of the presence of a layer of scale between the rivet head and the plate. The low-velocity stream of oxygen will not penetrate this scale without considerable preheat and the rivet head is removed long before the scale becomes sufficiently heated.

The special nozzle is 50 per cent faster than the standard nozzle in cutting buttonhead rivets, and it is the only satisfactory nozzle for cutting countersunk rivets. The low-velocity rivet-cutting nozzle operates effectively at a cutting-oxygen pressure of from 20 to 25 lb. per sq. in. for any type of rivet up to 1 in. in diameter. Larger rivets may require slightly higher oxygen pressures depending upon their size.

Cutting Countersunk and Buttonhead Rivets

To remove a countersunk rivet from a vertical sheet, stand to one side of the rivet and hold the blowpipe so as to direct the preheating flames at the center of the rivet head. The rivet-cutting nozzle should be at right angles to the surface of the plate and in line with the shank of the rivet as shown in Fig. 1. Hold the blowpipe steady until the area directly below the preheating flame becomes a bright red. Then open the cutting-oxygen valve and, as the metal oxidizes under the cutting jet, swing the blowpipe with a slow circular motion, at first over an area of about ¼ in. in diameter. When the coned head has been burned through to the body or shank of the rivet, remove the remainder of the head with one circular "wiping" motion, working outward from the center. The blowpipe should be held with the nozzle pointing at the base of the countersink throughout the operation.

The procedure for cutting buttonhead rivets with the low-velocity nozzle, Fig. 1, is similar to that for countersunk rivets. Start at the center of the head with the nozzle pointed along the center line of the rivet, preheat, and burn the rivet head until the shank or body of the rivet is reached. Then remove the balance of the head with a single circumferential "wiping" movement. Point the cutting-oxygen jet at the outside edge of the rivet hole in the outside sheet and follow the circumference around. The ring of metal (outside edge of the rivet head) which is left will fall away by itself.

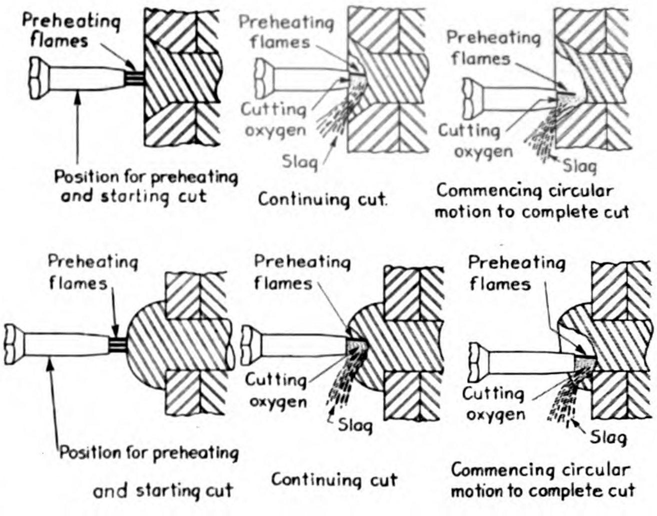

Fig. 1—Correct procedures for cutting countersunk (top) and button head (bottom) rivets with the low-velocity nozzle

Rivet-Cutting with Standard Nozzle

Where the low-velocity nozzle is not available, buttonhead rivets can be cut off by using a standard cutting nozzle as shown in Fig. 2. Use the size nozzle and oxygen pressure recommended by the manufacturer of the blowpipe for cutting steel 1 in. thick. Hold the nozzle parallel with the surface of the sheet, preheat, and cut a slot in the rivet head from the top of the button to the underside of the head, similar to the screw-driver slot in a round-head screw. In the cutting of the slot, the entire head will be preheated to a cutting temperature. As the cut nears the plate, draw the nozzle back at least 1½ in. from the rivet. Then, just as the slot reaches the plate, swing the nozzle through a small arc, slicing off half of the rivet head. Then immediately swing the nozzle in the opposite direction to take off the other half of the rivet head.

The nozzle must be drawn back from the rivet a distance of 1½ in. or even more while the bottom of the slot is being reached and just before cutting starts at the surface of the plate. This action permits the oxygen to scatter slightly before it strikes the rivet, and prevents

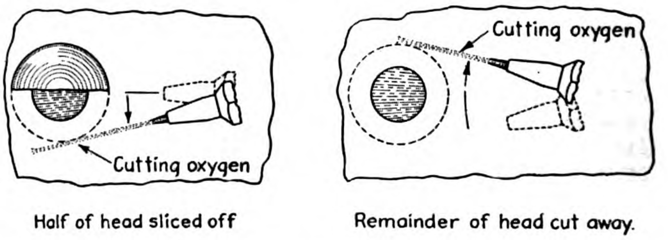

Fig. 2—These sketches show the proper manipulation of a standard cutting nozzle in removing the head of a buttonhead rivet

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* Reprinted from the January, 1941, issue of Oxy-Acetylene Tips.

the jet from breaking through the layer of scale that is always present between the rivet head and the plate. As a result, the button drops off flush without damaging the base metal. If the nozzle is not drawn away, the force of the oxygen jet may pierce the film of scale and damage the plate.

Removing the Rivets

The low-velocity nozzle is specifically made so that it can be used to penetrate a rivet shank two or three plate thicknesses, or to pierce the entire shank, as desired by the operator. However, in normal practices, most operators prefer simply to remove the rivet heads as previously described and then back out the rivets with a hammer and punch.

Lafayette Air-Brake Repair Shop

The new air-brake room of the Chicago, Indianapolis & Louisville (Monon), located in the east end of the locomotive erecting shop at Lafayette, Ind., covers a floor space of 24 ft. by 58 ft. and was designed to consolidate all air-brake repairs at one central point, including other work of a similar nature formerly performed in other parts of the shop under handicap. It consists of six sub-departments, as follows: (1) Injector and lubricator repairs; (2) air-compressor repairs; (3) repairs to air-brake equipment, other than compressors, bell ringers, fire-door cylinders, pop valves, steam gages, etc.; (4) triple-valve repairs; (5) air-, steam- and signal-hose assembly, and (6) cab fittings, angle and cut-out cocks, and globe valves.

Each department is equipped with a work bench, necessary wrenches, reamers, and other small tools peculiar to its particular work. The tools are arranged on racks in such a manner that they may be quickly secured. Each department also is equipped with a rack on which a fixed stock of common repair parts is maintained. This material conveniently at hand expedites the repairs and reduces to a minimum the delay caused waiting for material. This fixed stock is checked by the stores department at regular intervals and the supply replenished as required. Acid and lye-cleaning vats are available to all departments.

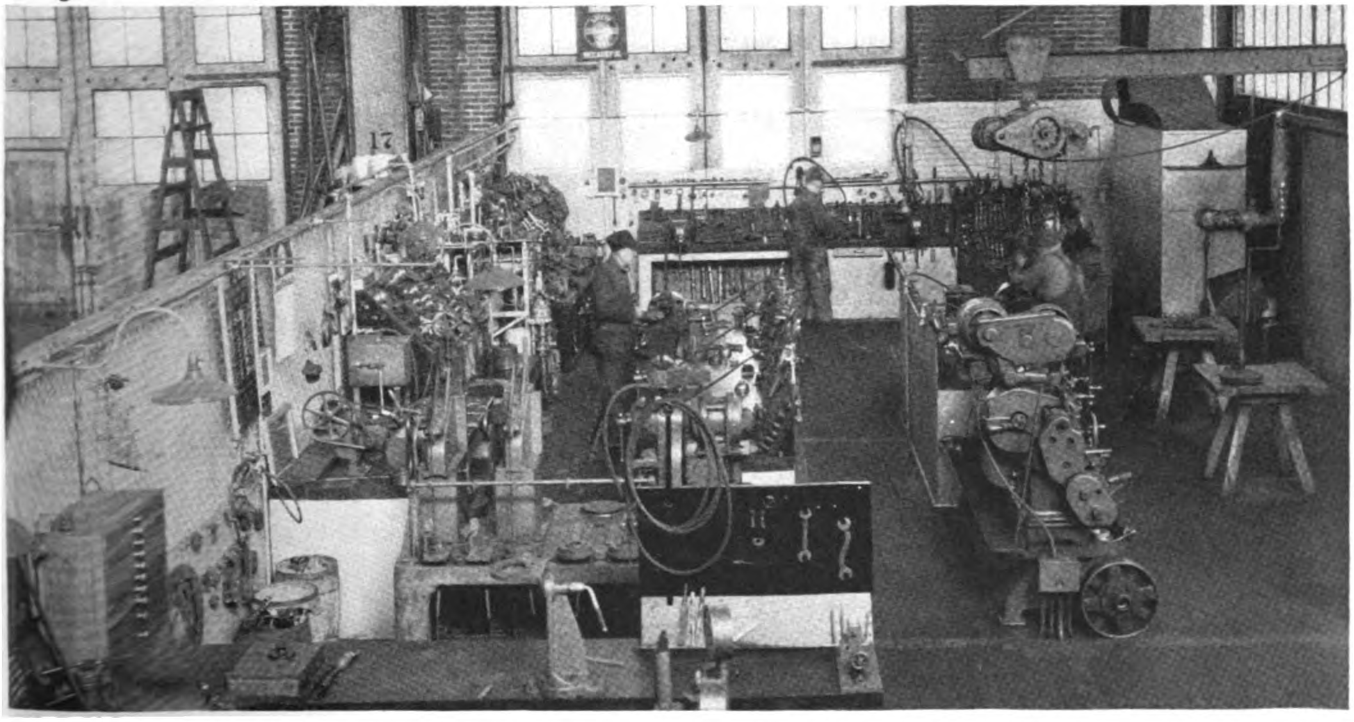
All machines are located to afford accessibility for any and all departments. The location of the air room permits the efficient handling of a compressor from the air room to the locomotive or vice versa. Likewise, by use of wire baskets, equipment removed from locomotive is carried by a crane direct to the air room for repairs.

Department No. 1 has a lubricator testing rack on which mechanical lubricators are tested under the same conditions which prevail on the locomotives in service. Gages and graduated glasses permit the operator to determine accurately the condition of the pumping units of the lubricators.

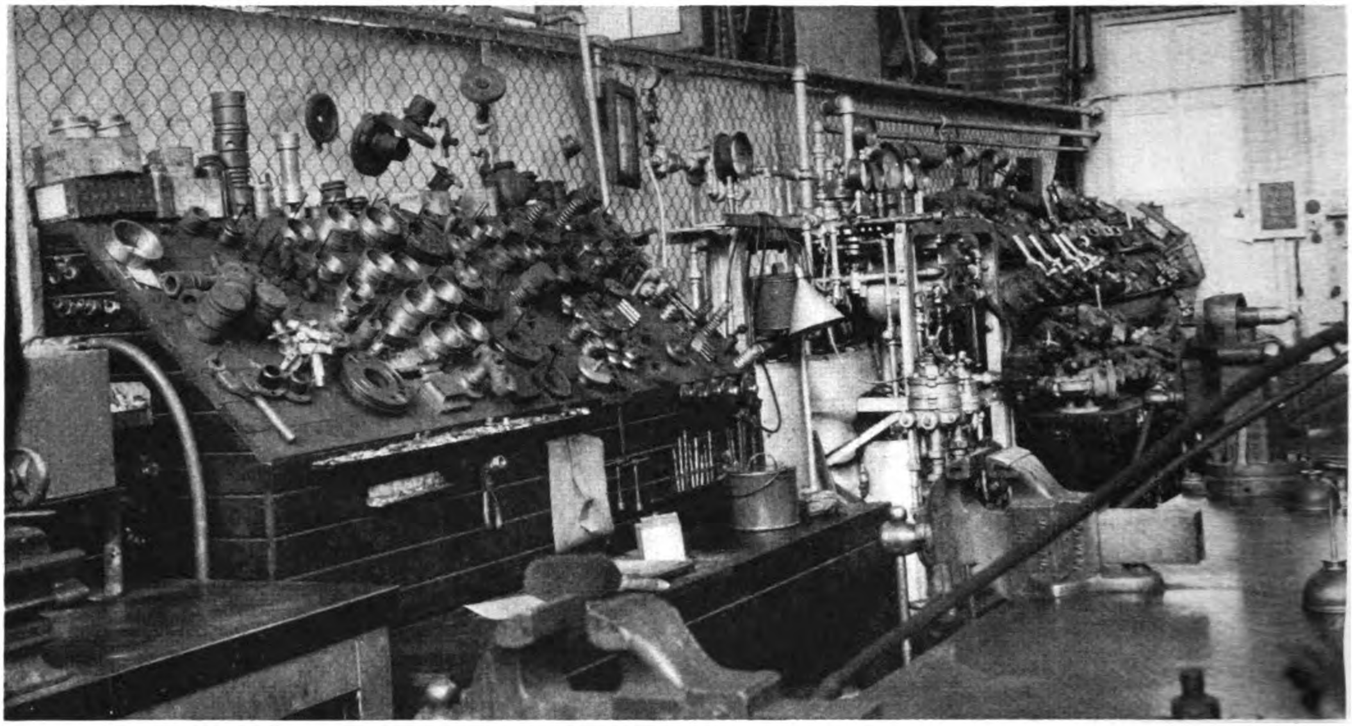
Department No. 2 has additional facilities of two racks on which locomotive air compressors are placed while undergoing repairs. It also has an 18-in. Lehman engine lathe, 8-in. pedestal-type emery wheel, and a one-ton electric hoist mounted on a jib crane over the racks, permitting handling of compressors without the use of the traveling crane. Accurate records are maintained by this department on cost of repair parts, labor to repair and service life of all compressors.

Department No. 3 is equipped with a test rack for testing individual parts of the air-brake equipment, also a 9-in. by 4-ft. South Bend bench lathe with 5-in. universal chuck to permit precision work and rapid handling of small parts requiring lathe work. For the grinding of valves and seats of the many different valves handled by this department, a semi-automatic valve-grinding machine is available, on which many valves may be semi-finished at the same time, eliminating tedious hand grinding individually. This valve grinder also is available to Department No. 4 as well as the necessary testing racks for this department.

Department No. 5 consists of the racks and air-



General view of the new air-brake repair shop of the Monon at LaFayette, Ind.



How standard repair parts and tools are kept readily available

operated machines necessary for the mounting of the various hose.

Department No. 6 consists of a grinding machine for angle cocks and other cone-seated valves, as well as necessary testing apparatus.

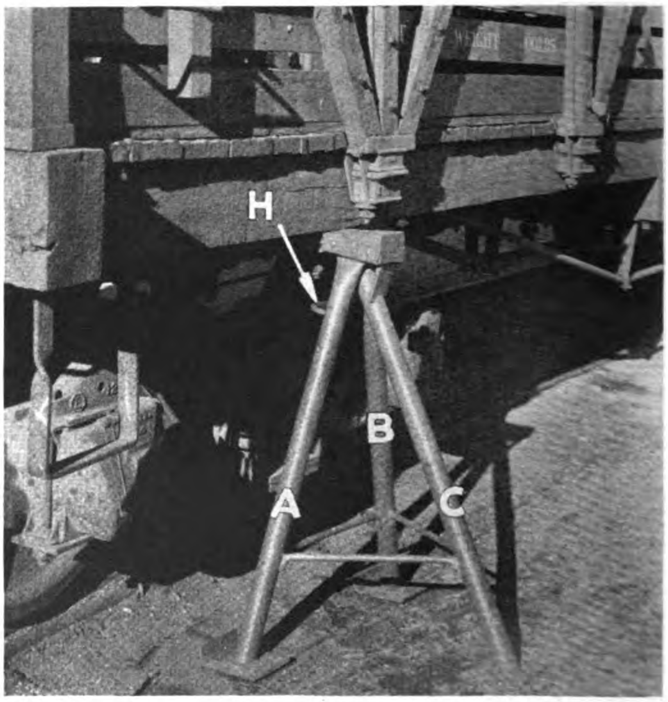
Material for shipment to other points on the line is easily removed by the stores department without inconvenience to other departments in the shop. The air room has sufficient natural light, but floodlights and individual bench lights afford good lighting under all conditions.

An important feature not previously mentioned is the design of benches and material racks so that all material and tools must be in sight. Also, thought was given to the layout in order to prevent so far as possible the accumulation of any parts or material on the floor of the shop. This feature of the shop automatically adds to the neatness and efficiency, and supervision accomplishes the balance that is not automatically cared for.

A Light, Strong Car Trestle

The illustration shows a light but strong car trestle, made of welded tubular steel and used successfully at the Chicago, Burlington & Quincy car-repair tracks, Omaha, Neb. The trestle is 42 in. high and the three supporting legs are spaced 22 in. apart at the bottom. The two legs *A* and *B*, are made of a single piece of 2-in. pipe bent at the middle (which is the top of the trestle) and forming a pocket to receive the upper end of leg *C*, which is welded in place. All three legs are tied together at the bottom about 12 in. above the ground level by ⅝-in. tie rods securely welded to the respective legs, as shown.

A flanged steel plate 4½ in. wide by 7½ in. long is welded to the top of legs *A* and *B* and also has a small welded reinforcing plate connection to leg *C*. This bracket serves as a firm support for the taper wood bearing-block which is held in place by two rivets through the bracket flanges. To give increased bearing surface on the ground, each leg of this trestle is equipped with a 6-in. by 8-in. steel base plate, welded securely to the end of the leg, which has been beveled to the proper angle. The base plates on legs *A* and *B* are turned up slightly on one edge so that a car man, by taking hold of handle *H* near the top of the trestle with one hand can easily pull the trestle from one place to another about the repair yard. In spite of its light construction, this car trestle is unusually strong, each trestle being tested with a load of 40,000 lb. before being placed in actual service.



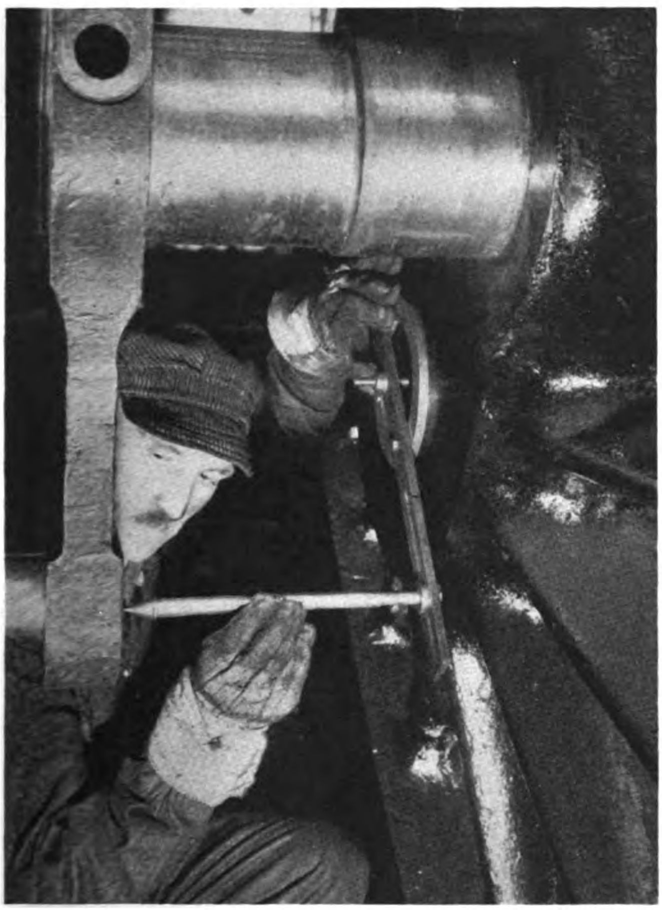
Welded tubular steel car trestle used at the Omaha car-repair tracks of the C. B. & Q.

Crank-Arm Positioning Gage

To the small-shop valve setter new main crank pins mean additional labor because they are usually installed before the bolt slot and keyway are machined. This is often done by the valve setter after he has located the crank arm in its proper position.

The location of the eccentric crank arm is important as any slight deviation from its predetermined location may mean a radical distortion in the valve events. Many different gages and trams are used for this purpose. The accompanying illustration shows one that is both simple to make and easy to use. This gage is readily adjustable to different lengths from the eccentric-pin center to the main axle center; also from the driving-wheel face to the back of the crank arm.

The circle of the gage that fits tight against the axle face is made of brass or steel 3/8 in. thick and 7 in. diameter. The inside diameter is 4 7/8 in. The bar is made from 3/8-in. by 1 1/2-in. soft steel 16 1/2 in. long. This bar has a 3/8-in. slot 7 in. long milled in it near the end and the bar is secured to the circle with 1/4-in. cap screws. In the center of the circle, the bar is drilled and tapped with 1/2-in. U.S.S. threads and through this hole is screwed the adjustable center. This center can be raised or lowered so that it will fit snug in the center hole of the axle when the circle is tight against the axle face. It is locked in position with a wing nut. The rod that slides in the slot is threaded for 1/2 in. on the back, then filed flat on two sides to fit into the 3/8-in. slot. The thin nut that fits on the end of this rod is 5/16 in. thick and the body of the rod is turned to fit the inside of a piece of 1/2-in. brass pipe about 8 1/2 in. long with a point screwed in the outside end.



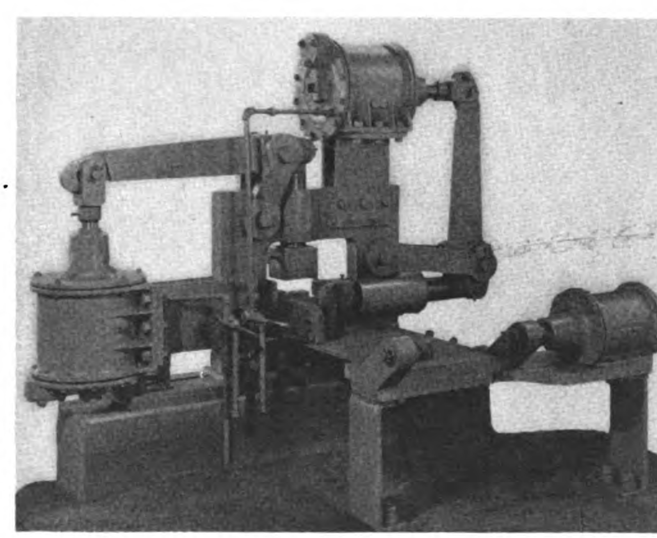
The ring of the gage is centered against the axle end and the position of the eccentric crank arm is located by the pointer

The gage is set to the required blue-print distance from the axle center to the crank arm pin center. The crank arm is placed on the pin in its approximate position and the gage held against the axle face with the center of the gage tight in the axle center. Both the gage and the crank arm are moved until the point of the gage coincides with the center of the eccentric-crank-arm pin. The crank arm is now in its correct position and the keyway and bolt slot are laid out for machining. Irrespective of other adjustments that may be necessary to square valves, the crank-arm setting is fixed.

Spring Assembling and Banding Machine

The spring assembling and banding machine, shown in the illustration is in use in the blacksmith shops of the Chicago, Indianapolis & Louisville (Monon), at La-Fayette, Ind. It was constructed at an approximate cost of $850 and is used for the assembling of plates and tightening of bands on locomotive driving, trailing-, engine- and tender-truck springs.

The banding machine proper consists of a cast-steel frame upon which are mounted two 16-in. by 12-in. brake cylinders, necessary fulcrum arms and plungers, all of which are placed in such position that pressure may be exerted both horizontally and vertically on spring bands during the process of tightening them around the assembled plates. This frame is bolted to an iron bed plate mounted on a concrete base suitable in height to bring the table of the banding machine 26 in. above the floor level. The assembling machine consists of a 10-in. by 12-in. brake cylinder, operating plunger and stationary head mounted on a base level with the base of the banding machine. These two machines are connected by 3/8-in. boiler plate so that springs may be transferred from the assembling machine to the banding machine without the use of crane or hoist. Both the operating plunger and stationary heads of the assembling machine have notched faces to grip and hold spring plates and are mounted on ball bearings in order that springs may be revolved to either a vertical or horizontal position dur-



Spring assembling and banding machine built and in use at the LaFayette shops of the Monon

ing the process of assembling, preparatory to being placed in the banding machine. The various brake cylinders are independently actuated by compressed air, controlled by three-way valves.

The cast-steel frame of the banding machine is 4½ in. thick, overall dimensions 35 in. by 41 in., inside dimension 15¾ in. by 19¾ in. Fulcrum arms are cast steel, have a ratio of six to one, and are tapered from 7 in. by 9 in. at the fulcrum to 2½ in. by 5 in. at the long ends and 7 in. by 8 in. at the short ends. The long ends of these levers are slotted 2½ in. by 5¼ in. and connected to the brake cylinder piston by roller bushing so that the piston will not be out of alinement at the various angles of fulcrum levers. The bed plate of the banding machine is 2½ in. by 15 in. by 73 in., and is fastened to a cast-steel frame by ¾-in. by 5-in. by 6-in. by 41-in. angles. These angles are secured by bolts and are electrically welded around the edges. The plunger heads are finished to allow for the largest spring bands and necessary spacer blocks are used for smaller bands.

The clearance between the plunger head and the stationary head on the assembly machine is made ample to receive the largest spring used. The tightening of loose spring bands is brought about by placing the spring in the position shown in the photograph. Pressure is exerted against the band horizontally and the top side of the band is heated with oxy-acetylene flame in order to upset the band. When the band has been upset sufficiently, pressure is applied by the vertical plunger to force the band firmly against the edges of the spring plates. The spring is then turned over and the opposite side of the band is subjected to the same process after which the spring is placed in a No-oxide bath.

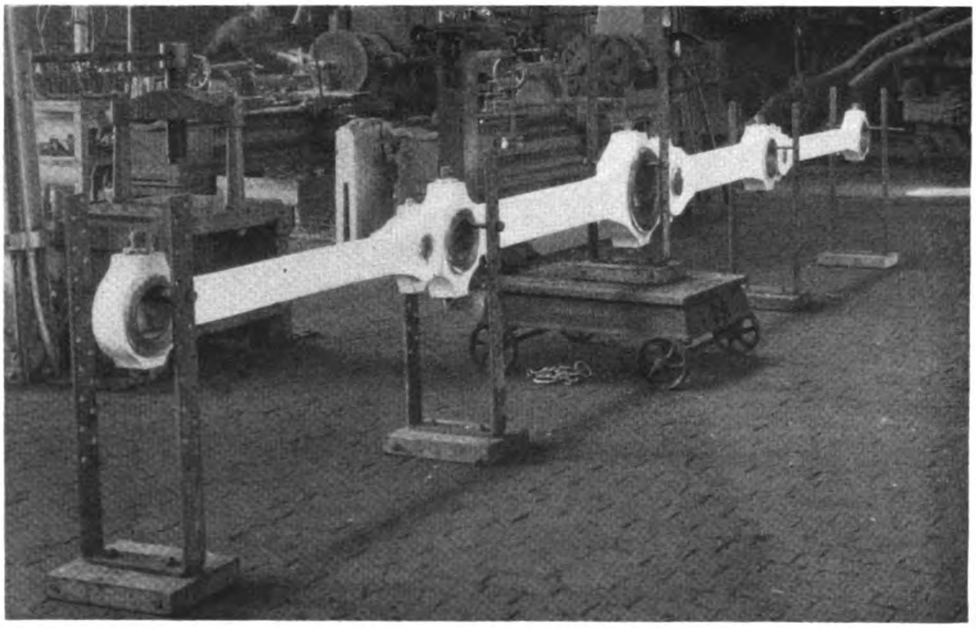
This machine was placed in service on June 17, 1940, and savings over former methods are said to have paid for it in five months.

Counterbalancing Driving Wheels

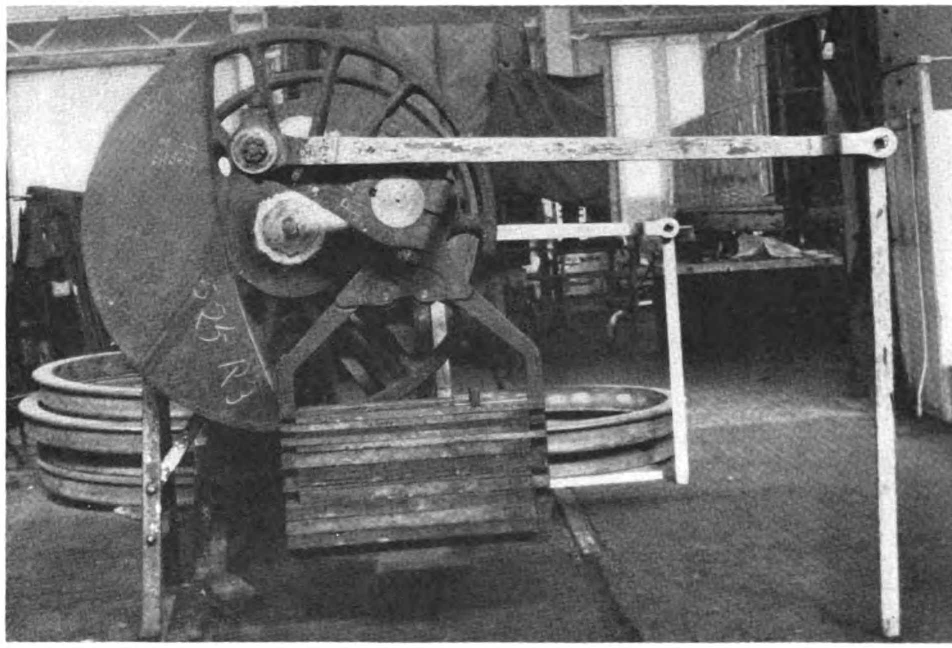
In order to obtain the actual weights of revolving and reciprocating parts on locomotives for the purpose of counterbalancing, the rod supports or stands shown in one of the illustrations, are used at the Chicago, Indianapolis and Louisville shop, Lafayette, Ind. These stands consist of ½-in. by 3-in. steel bars, bent to the shape indicated and bolted to 2½-in. by 12-in. by 15-in. oak base blocks. The vertical legs, 36 in. high are drilled with staggered ¾-in. holes spaced 3 in. apart. The side rods are assembled completely in order that all parts may be accurately weighed. They are then hung on the stands, leveled as shown, and supported practically on knife edges which consist of ¾-in. bolts running through the holes at the desired location on the stand. Pieces of pipe are placed loosely over these bolts in order to eliminate any tendency for the rods to bind at the point of support. The knuckle joints are lubricated and permitted to work freely in order to show the proper weight at each pin. The scale is then placed under each stand, as indicated, in order to obtain the weight at that particular pin hole.

After these weights have been obtained, the rods are dismantled and all placed on the scale in order to obtain the total weight. The sum of the weights previously obtained at the pin holes must equal the total weight of the rods so weighed. The front and back ends of the main rods are similarly weighed in order to obtain the distribution of weight at each end. All reciprocating parts, such as piston, crosshead, cylinder packing, crosshead key, union link, and necessary pins, nuts and washers are likewise weighed on the scale. The weights so obtained are recorded on a form and forwarded to the mechanical engineer's office where the theoretical weights to be counterbalanced at the pin at each location are calculated in accordance with the latest recommended practice.

After these weights have been determined, the driving wheels are then placed on the balancing stand, as shown in the second illustration. The top of the balancing stand consists of two parallel steel strips, machined accurately 3½ in. by 3½ in. by 36 in. in length. The driving journals rest on these parallel strips, which are leveled accurately, both before and after the driving wheels are placed in position, in order to permit wheels to roll easily. A yoke containing a roller bearing is then hung over the pin to be balanced. In the yoke is placed the theoretical weight desired to be balanced on that pin. This weight consists of brass plate castings, which are of various dimensions and convenient size and weight, with weights stencilled on them. The weight of the yoke itself is also known.



Supporting stands and platform scale used in determining rod weights on individual crank pins at the Monon - locomotive shop, Lafayette, Ind.



Parallel-bar stand and equipment used in counterbalancing locomotive driving wheels—In the case of main drivers, both the eccentric and rods are applied

After this weight is placed on the pin to be balanced, and all rollers and other moving parts properly oiled, the eccentric crank and eccentric rod are assembled on the main pins in proper operating position, as illustrated, and a double plumb line is then thrown over the opposite pin. A circle is accurately scribed from the center of the axle equal to the diameter of the pin. With the theoretical weight, plus the actual other weights to be counterbalanced, hanging on the pin, the counterbalance on the side of the pin in question is now increased or decreased by proper mechanical methods until the plumb lines coincide with the scribed diameter of the opposite pin on the axle.

Of course, the eccentric crank and rod are not used on other than main wheels. It is good practice to try both sides of a pair of wheels before making any actual change in counterbalance weight, because any change on one side will affect the weight of the other. After changes in counterbalances are made, the wheels are re-checked until the desired accuracy is obtained.

Locomotive Boiler Questions and Answers

By George M. Davies

(This department is for the help of those who desire assistance on locomotive boiler problems. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless special permission is given to do so. Our readers in the boiler shop are invited to submit their problems for solution.)

Welding Flues with Empty and Filled Boiler

Q.—When welding flues to the firebox tube sheet of a locomotive boiler, is it preferable to have water in the boiler at the time of welding?—K. I. M.

A.—The advantage of welding the flues in the firebox tube sheet with water in the boiler is that the heat is dissipated more rapidly than when the boiler is dry. This allows the welder to proceed without making any allowance for the effect of the heat of the arc upon the flue sheet. In welding the flues in the flue sheet when the boiler is dry, the welder must first weld one row of flues, then skip a row and weld the next row. With a dry boiler, one-half the circumference of the flue is welded at a time, the second half being welded after the first weld has cooled so the heat of the arc will not set up stresses in the flue sheet and cause it to warp.

Either method of welding the flues is satisfactory; the matter of preference depends on conditions in the shop in which the work is being done.

Application of Larger Boiler Check Valve

Q.—We have several Mikado-type locomotives operating at 200 lb. per sq. in. boiler pressure on which we desire to increase the size of the boiler check valves from 2 in. to 2½ in. The check valves now on the engine have a 3¼-in. hole in the shell and are secured with six ⅞-in. studs on a 5¾-in. stud circle. There is a 9-in. by 9-in. by ⅝-in. square liner on the inside of the shell secured with four ¾-in. rivets, while the new check valve requires a beveled seat and is secured with six ⅞-in. rivets on a $6\frac{1}{16}$-in. circle.

Due to the fact that the stud circle in the boiler is not suitable for the new check valve, will it be necessary to relocate the boiler checks and plug up the old holes in order to make this application?—M. E. D.

A.—Fig. 1 illustrates the boiler-check hole and liner as outlined in the question. It would be possible to apply the 2½-in. boiler check in the same location as the present boiler check by applying an outside liner to the boiler in the manner as illustrated in Fig. 2. It will be noted, however, that to do this, the flanges on the 2½-in. check

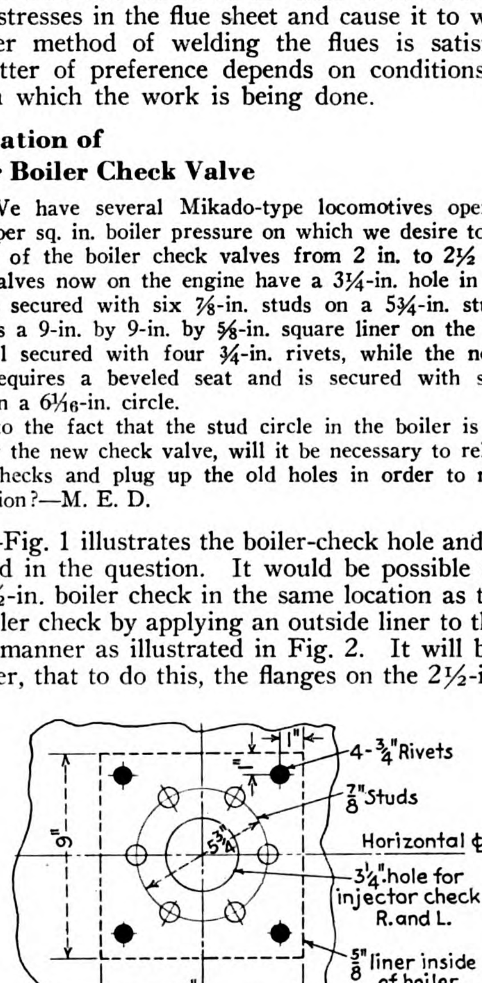


Fig. 1—Original boiler check hole and liner

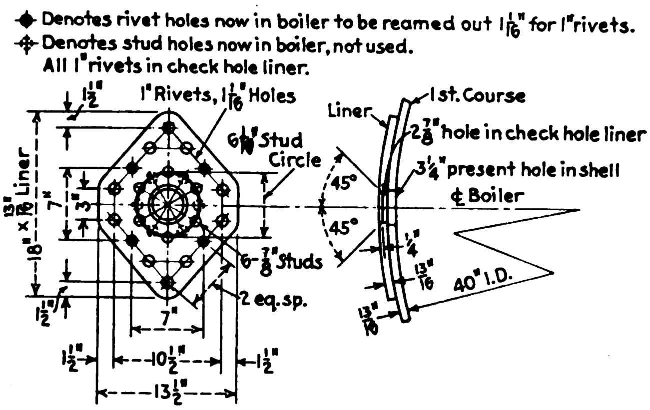


Fig. 2—Application of outside liner permits the use of a larger check valve in the same location as shown in Fig. 1

will have to come drilled so that the studs will fall directly between the studs now in the boiler. With this method of application the bevel seat for the boiler check can be made in the liner which will cover the original hole in the shell.

In applying this liner, the original liner on the inside of the shell should be removed. The liner illustrated in Fig. 2 is only for the application of a new boiler check and is not intended to be used for repairing cracks in the original boiler-check hole or any other defects at this point.

Disadvantages of Diamond-Shaped Seam

Q.—Although the diamond-shaped seam has greater efficiency than all other types of seams, it is seldom used for the longitudinal seam of a locomotive type boiler. Why?—W. F. H.

A.—Although the diamond-shaped seam has almost 100 per cent efficiency and would, therefore, appear to be the most advantageous because its use permits a reduction in the thickness of the shell and thereby reducing the weight and cost of the plates, construction details are such that these advantages cannot readily be obtained in practice.

As the inner welt of this type of seam has to be quite extensive in size, the weight saved in the shell itself is mostly replaced by the weight of the inner welt strip. The size of these welt strips is also a disadvantage in that it frequently causes the strip to interfere with some accessory or fitting requiring rivets or studs in the shell. Furthermore, holes through the seam in line with any of the seam rivets in the inner weld would reduce the efficiency of the seam which would defeat the purpose of using this type of seam.

The most practical type of longitudinal seams for use on locomotive boilers are the sextuple with 82 to 85 per cent efficiencies, the octuple with 87 to 93 per cent efficiencies and the decuple with 93 to 98 per cent efficiencies.

What Is Caustic Embrittlement?

Q.—What is caustic embrittlement?—E. R. M.

A.—Caustic embrittlement is the term applied to the chemical intercrystalline fracture of riveted seams in boilers. The features of these fractures in boilers are characteristic and well defined, and for all practical purposes are independent of the quality of steel employed in their construction.

They are: (1) The cracking is confined to the riveted seams. The plates away from the seams are unaffected. Joints above and below the water level are equally liable to have this form of cracking. (2) The cracking begins at rivet holes and on the surfaces in contact, not at the outside surfaces. (3) The cracking of the plates is usually accompanied by the breaking off or cracking of the rivet heads, and this is usually the first observable symptom. (4) The path of the cracks is along the grain boundaries and is not transcrystalline as is the case with fatigue failure.

Saturated and Superheated Steam

Q.—What is the difference between saturated and superheated steam, and what is wet and dry steam? Can superheated steam be wet or dry steam?—W. I. D.

A.—Saturated steam is steam in contact with the liquid water from which it was generated at a temperature which is the boiling point of the water and the condensing point of the steam. Dry saturated steam is steam free from mechanically mixed water particles. Wet saturated steam on the other hand contains water particles in suspension. Saturated steam at any pressure has a definite temperature.

Superheated steam is steam at any given pressure which is heated to a temperature higher than the temperature of saturated steam at that pressure. Water cannot exist in superheated steam. Therefore, all superheated steam is dry steam.

Recommended Practice for Smokebox Areas

Q.—In checking the smokebox areas of a Mikado type engine, where the areas are based on the cross-sectional area of the tubes and flues, should the area of the superheater units be deducted from the flue area or should the total flue area be taken? What is the recommended practice for smokebox areas?—J. B. S.

A.—The smokebox areas (or gas area for draft) should be based on the net cross-sectional area of the tubes and flues. This equals the sum of (1) the total internal cross-sectional area of all tubes and (2) the total internal cross-sectional area of all flues minus the total external cross-sectional area of all superheater units. Superheater bands and supports are not considered as limiting the cross-sectional area of the flues.

Example:

Given, a boiler having forty 5 3/8-in. O. D. flues, No. 9 B. W. G. thick, and two hundred fifty, 2-in. O. D. tubes, No. 12 B. W. G. thick. The boiler is equipped with a type *A* superheater.

The internal area of the 5 3/8-in. flue is 20.26 sq. in. The internal area of each 2-in. tube is 2.49 sq. in. Superheater units are of 1 1/2-in. O. D. seamless steel, No. 10 B. W. G. thick. Each unit is composed of four pipes. The external area of one pipe = 1.77 sq. in.

$$1.77 \times 4 = 7.08 \text{ sq. in. per unit}$$

Total cross-sectional area of tubes and flues:

$$250 \times 2.49 = 622.5 \text{ sq. in.}$$
$$40 \times (20.26 - 7.08) = 527.2$$
$$\text{Total} = 1{,}149.7 \text{ sq. in.}$$

The A. A. R. recommends smokebox areas for the Master Mechanics' front end based on the net cross-sectional area of the tubes and flues representing 100 per cent, as follows:

Gas Area	Permissible, per cent	Preferred, per cent
Minimum net gas area through tubes and flues	100	100
Net gas area over arch	110-120	115
Maximum gas area under table plate	95-110	95
Minimum gas area under table plate	80- 95	85
Area under draft sheet	65- 80	75
Net area through netting	110-140	130
Minimum area of stack	23- 27	25

(*Turn to next left-hand page*)

A 3 YEAR RECORD OF CHILLED WHEEL PROGRESS

Users of chilled car wheels find that steady improvements in manufacturing make these 4 savings greater than ever before.

1. Lowest cost per mile
2. Increased Rail Life
3. Increased Brake Shoe Life
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ASSOCIATION OF MANUFACTURERS OF CHILLED CAR WHEELS

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High Spots in
Railway Affairs . . .

Railroads Transport Military Personnel

While it has not attracted much attention, the railroads are being called upon to transport large numbers of officers and men of the Army, Civilian Conservation Corps, Marine Corps and Navy, as well as draftees. A statement from the Association of American Railroads indicates that more than 207,000 officers and men were transported in January "without the slightest difficulty or interference with other traffic." While many of these men were transported on regular trains, 385 special trains were required in that month.

C. of C. on Consolidations

A report on railroad consolidation has been made by the Transportation and Communication Department Committee of the Chamber of Commerce of the United States. It points out that the carriers "have both the need and opportunity now, as never before, to streamline their plant, cut away unnecessary trackage and service, and establish a practical working base on which they can hope to utilize their inherent advantages and earn a fair return under fair regulation of all competing forms of transportation." It points out that consolidation should facilitate abandonment of branch lines, which are no longer profitable and which frequently more than eat up the earnings of the main lines.

St. Lawrence Project

The Department of Commerce, at the request of President Roosevelt, is making a series of reports on the economic aspects of the St. Lawrence waterway and power project. The first of seven reports was made in February. It is entitled "History of the St. Lawrence Project," and is in the form of a 39-page document. It outlines the various governmental and other surveys of the St. Lawrence which have been made from time to time and discusses also the negotiations and treaty making efforts of the United States and Canada. In relation to national defense, it characterizes President Roosevelt's recent message to the St. Lawrence Seaway Conference as a dramatic presentation of the thought that the seaway, "long defended as a great improvement to facilitate normal trade relations, is even more important in times of emergency." At a press conference on February 11, President Roosevelt said that the St. Lawrence question is something for Congress to decide. He did not say, however, when he might again request Congress to consider it.

Mosquitos in London Subways

The use of the London subway or tube stations for air raid shelters and as sleeping quarters has had one unusual and quite unexpected result. Conditions have proved favorable to the propagation of mosquitos, and this not alone during the summer season, but during the entire year. There always have been shallow, stagnant pools of water, but otherwise conditions were unfavorable for the breeding of mosquitos. Now the all-night residents furnish an abundant food supply, the temperature is frequently above 70 deg. F., and there is an absence of all natural enemies. This makes possible the continuous breeding throughout the year. Steps are being taken to overcome this nuisance by spraying with the proper chemicals.

Export Traffic Handled Efficiently

Railroaders still recall with feelings of discomfort the traffic congestion at the ports during the first World War. That advantage is being taken from the lessons learned at that time is indicated by the facility with which the railroads are now able to unload their freight cars and keep them on the move. In January of this year, for instance, 41,909 cars of export freight, other than grain, were unloaded at Atlantic and Gulf ports. Only 2,012 cars of grain for export were unloaded in the same month, as compared with 6,208 last year. Ralph Budd, Transportation Commissioner of the National Defense Advisory Commission, made the statement in an official bulletin of that Commission that "during 1940, increases in export movement through certain North Atlantic ports —as high as 100 per cent over 1939 levels and approximately equaling the 1918 peak —have been handled without congestion and without undue detention of loaded freight cars or overcrowding of terminal facilities." This has been made possible by the close and intelligent co-operation exercised by the government departments, the national defense organization and the Association of American Railroads.

Vacations with Pay

About 750,000 employees of 14 non-operating railroad unions have received ballots to vote on the question of striking to enforce their demand for two weeks' vacation with pay. George M. Harrison, president of the Brotherhood of Railway Clerks, is heading up the fight. After a visit to the White House he indicated that he had laid the situation before the President, expressing "our regret over the necessity for pursuing the case in this manner in view of the defense situation"; but "there is no other course." If the vote favors a strike, Mr. Harrison expects the case to go to an emergency board appointed by the President. That board would have 30 days to make its report and status quo must be maintained for 30 days after the making of the report. Mr. Harrison estimates that the granting of these demands will cost the railroads about $38,000,000 a year.

Grade Crossing Accidents

During 1940 there were 1,814 fatalities resulting from accidents at highway-railroad grade crossings, according to the Safety Section of the Association of American Railroads. This is greater than in any year since 1930, except for 1937 when there were 1,875 such fatalities. It marks an increase of 416 over 1939 and 297 compared with 1938. The increase is said to be due largely to the fact that more trains and automobiles were in operation. That many of these accidents are due to gross carelessness and thoughtlessness is indicated by the fact that about 80 per cent of them involved motorists at crossings in the vicinity of their homes.

Transport-Study Board

Although the Transportation Act of 1940 directed the President to appoint a study board, no progress seems as yet to have been made in that respect. While Congress regarded this as a vital matter, the railroads apparently must patiently await their turn until the powers that be get ready to act. It has been suggested that Owen D. Young, the retired chairman of the General Electric Company, who is directing the National Resources Planning Board's transportation study, would be an ideal man to head up the new board. It is understood, however, that he does not care to function in that capacity. The National Resources Board has made some considerable progress in its studies and there is a possibility that these may be available for the use of the new board which is required by the Transportation Act.

(Turn to second left-hand page)

NCING

THE Franklin System of Steam Distribution was disclosed to railroad men at the Atlantic City Convention in 1937.

Pursuant to the statement made at that time that this was under test development, the Franklin Company built a complete Steam Distribution System which was subjected to extensive laboratory tests on a test plant especially constructed for the purpose. This unit was operated twenty-four hours a day for the equivalent of 155,000 miles at an operating speed of eighty (80) miles per hour.

From time to time changes in details were made in the design. After the tests were completed, a second unit was built and operated on the test plant under similar conditions, for a total of 35,000 miles.

This unit was then applied to one of The Pennsylvania Railroad high-speed Pacific type passenger locomotives, and after a few weeks' service was subjected to extensive dynamometer tests in road service by the Railroad.

The locomotive was then operated in regular pool service on high-speed runs and after a year's service, and through the courtesy of The Pennsylvania Railroad, it was placed on the Pennsylvania test plant at Altoona and subjected to further exhaustive tests at speeds up to one hundred (100) miles per hour.

The results from this research program are so gratifying that the Franklin System of Steam Distribution is now offered to the railroads as a marked advance in the development of the steam locomotive.

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Among the Clubs and Associations

New York Railroad Club.—Meeting held February 20. Speaker: S. C. Johnson, assistant vice-president, Dearborn Chemical Company. Subject: The Behavior of Steam and Water in a Locomotive Boiler, illustrated by motion pictures of a boiler interior taken from the dome of a locomotive operating in fast freight service on the Missouri Pacific. Motion picture entitled "What Happens in a Locomotive Firebox?" Introductory remarks and explanatory comment by A. A. Raymond, superintendent fuel and locomotive performance, New York Central.

North American Airbrake Association.—The North American Airbrake Association was organized at a recent meeting in Parsons, Kan., by representatives of ten railroads and industries from Missouri, Kansas, Oklahoma, Illinois, and Nebraska. The program adopted for 1941 calls for a meeting at Kansas City in May and an annual meeting at Springfield, Mo., in September. Officers elected were as follows: President, W. E. Vergan, supervisor of airbrakes of the Missouri-Kansas-Texas; first vice-president, A. Malmgren, traveling fireman of the St. Louis-San Francisco; second vice-president, L. S. Bean, airbrake room foreman of the Missouri-Kansas-Texas; third vice-president, C. B. Tramblie, airbrake supervisor of the Chicago, Burlington & Quincy, and secretary-treasurer, C. R. Ehni, mechanical inspector of the St. Louis-San Francisco.

DIRECTORY

The following list gives names of secretaries, dates of next regular meetings, and places of meetings of mechanical associations and railroad clubs:

Allied Railway Supply Association. — J. F. Gettrust, P. O. Box 5522, Chicago.

American Society of Mechanical Engineers. —C. E. Davies, 29 West Thirty-ninth street, New York.

Railroad Division.—C. L. Combes, *Railway Mechanical Engineer*, 30 Church street, New York City.

Machine Shop Practice Division.—Warner Seely, Warner & Swasey Co., 5701 Carnegie avenue, Cleveland, Ohio.

Materials Handling Division. — F. J. Shepard, Jr., Lewis-Shepard Co., Watertown Station, Boston, Mass.

Oil and Gas Power Division.—L. N. Rawley, Jr., Power, 330 West Forty-second street, New York.

Fuels Division.—D. C. Weeks, Consolidated Edison Co., 4 Irving Place, New York.

Anthracite Valley Car Foremen's Assn.— Exec. sec., Walter B. Riggin, 215 Swartz street., Dunmore, Pa. Meets third Monday of each month at Wilkes-Barre, Pa.

Association of American Railroads.—Charles H. Buford, vice-president Operations and Maintenance Department, Transportation Building, Washington, D. C.

Operating Section. — J. C. Caviston, 30 Vesey street, New York.

Mechanical Division.—A. C. Browning, 59 East Van Buren street, Chicago. Meeting at Hotel Jefferson, St. Louis, Mo., June 19 and 20.

Purchases and Stores Division.—W. J. Farrell, 30 Vesey street, New York.

Motor Transport Division. — George M. Campbell, Transportation Building, Washington, D. C.

Canadian Railway Club. — C. R. Crook, 4415 Marcil avenue, N. D. G., Montreal, Que. Regular meetings, second Monday of each month, except June, July and August, at Windsor Hotel, Montreal, Que.

Car Department Association of St. Louis.— J. J. Sheehan, 1101 Missouri Pacific Bldg., St. Louis, Mo. Regular monthly meetings third Tuesday of each month, except June, July and August, DeSoto Hotel, St. Louis, Mo.

Car Department Officers' Association.—Frank Kartheiser, chief clerk, Mechanical Dept., C. B. & Q., Chicago. Annual meeting September 22, 23 and 24, 1941.

Car Foremen's Association of Chicago.—G. K. Oliver, 8238 S. Campbell avenue, Chicago. Regular meetings, second Monday in each month, except June, July and August, La Salle Hotel, Chicago.

Car Foremen's Association of Omaha, Council Bluffs and South Omaha Interchange.— H. E. Moran, Chicago Great Western, Council Bluffs, Ia. Regular meetings, second Thursday of each month.

Central Railway Club of Buffalo.—Mrs. M. D. Reed, Room 1817, Hotel Statler, Buffalo, N. Y. Regular meetings, second Thursday of each month, except June, July and August, at Hotel Statler, Buffalo.

Eastern Car Foremen's Association.—W. P. Dizard, 30 Church street, New York. Regular meetings, second Friday of January, February, March, April and October at Engineering Societies Bldg., 29 West Thirty-ninth street, New York.

Indianapolis Car Inspection Association. — R. A. Singleton, 822 Big Four Building, Indianapolis, Ind. Regular meetings, first Monday of each month, except July, August and September, in Indianapolis Union Station, Indianapolis, at 7 p. m.

International Railway Fuel Association.— See Railway Fuel and Traveling Engineers' Association.

International Railway General Foremen's Association.—See Locomotive Maintenance Officers' Association.

Locomotive Maintenance Officers' Association.—J. E. Goodwin, general foreman, locomotive department Missouri Pacific, North Little Rock, Ark. Meeting September 22, 23 and 24, 1941.

Master Boiler Makers' Association.—A. F. Stiglmeier, secretary, 29 Parkwood street, Albany, N. Y. Annual meeting September 22, 23 and 24, 1941.

New England Railroad Club.—W. E. Cade, Jr., 683 Atlantic avenue, Boston, Mass. Regular meetings, second Tuesday in each month, except June, July, August and September.

New York Railroad Club—D. W. Pye, Room 527, 30 Church street, New York. Meetings, third Thursday in each month, except June, July, August, September and December at 29 West Thirty-ninth street, New York.

North American Airbrake Association.—C. R. Ehni (secretary-treasurer), mechanical inspector, St. Louis-San Francisco, Springfield, Mo.

Northwest Car Men's Association. — E. N. Myers, chief interchange inspector, Minnesota Transfer Railway, St. Paul, Minn. Meetings, first Monday each month, except June, July and August, at Midway Club rooms, 1931 University avenue, St. Paul.

Northwest Locomotive Association. — G. T. Gardell, 820 Northern Pacific Building, St. Paul, Minn. Meetings last Monday of each month, except June, July and August.

Pacific Railway Club.—William S. Wollner, P. O. Box 3275, San Francisco, Cal. Monthly meetings alternately in northern and southern California.

Railway Club of Pittsburgh.—J. D. Conway, 1647 Oliver Building, Pittsburgh, Pa. Regular meetings, fourth Thursday in month, except June, July and August, Fort Pitt Hotel, Pittsburgh, Pa.

Railway Fuel and Traveling Engineers' Association.—T. Duff Smith, Room 811, Utilities Building, 327 South La Salle street, Chicago. Annual meeting, September 22, 23 and 24, 1941.

Railway Supply Manufacturers' Association. —J. D. Conway, 1941 Oliver Building, Pittsburgh, Pa.

Southern and Southwestern Railway Club.— A. T. Miller, P. O. Box 1205, Atlanta, Ga. Regular meetings, third Thursday in January, March, May, July and September. Annual meeting, third Thursday in November, Ansley Hotel, Atlanta, Ga.

Toronto Railway Club.—D. M. George, Box 8, Terminal A, Toronto, Ont. Meetings, fourth Monday of each month, except June, July and August, at Royal York Hotel, Toronto, Ont.

Traveling Engineers' Association.—See Railway Fuel and Traveling Engineers' Association.

Western Railway Club.—W. L. Fox, executive secretary, Room 822, 310 South Michigan avenue, Chicago. Regular meetings, third Monday in each month, except June, July, August and September.

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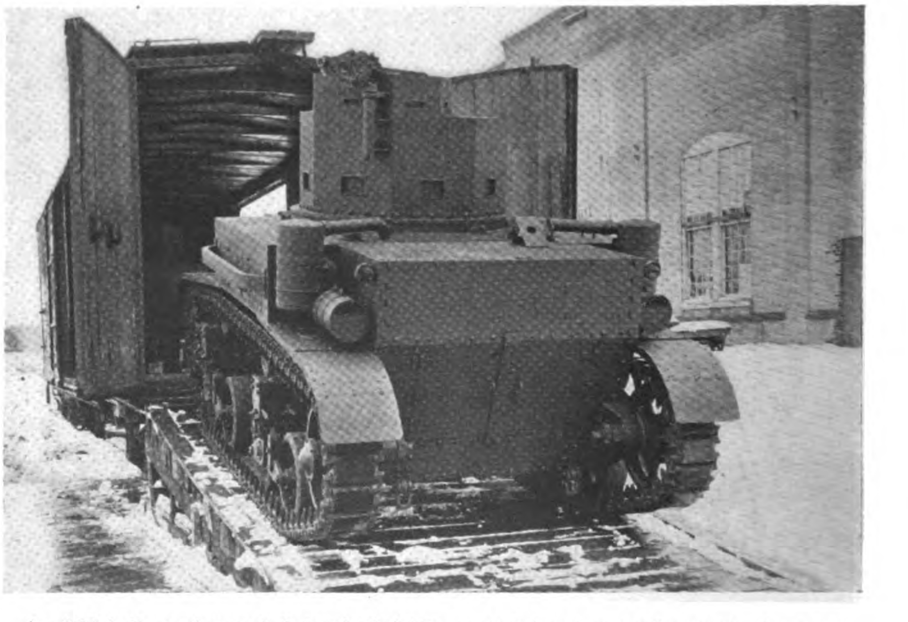

An ACF-built combat tank being loaded into an end-door box car by means of a ramp

NEWS

Santa Fe Diesel Locomotive Freight Run

The new 5,400-hp. Diesel-electric freight locomotive, recently delivered to the Atchison, Topeka & Santa Fe by the Electro-Motive Corporation, General Motors subsidiary, La Grange, Ill., and placed in regular main-line freight service at Argentine, Kan., on Feb. 5, completed its first run to Los Angeles, Calif., on February 8. In handling this freight train the Diesel-electric locomotive demonstrated notably reliable performance, ample power to haul the train up heavy grades, and ability by means of the dynamic braking feature to ease the train down heavy grades with substantially less air-brake application and attendant wheel heating and brake-shoe wear.

The test was witnessed by responsible officers and engineers of both the railway and the locomotive builders and press representatives, who were accommodated in five business cars coupled back of the locomotive and dynamometer car and just ahead of the mixed freight cars and caboose which constituted the rest of the train. No special attempt was made for a speed record, the usual number of delays for passenger and other train meets being encountered.

The train consisted of between two and three thousand tons in a varying number of cars from 49 to 68, and was handled a distance of 1,782 miles from Argentine, to Los Angeles, in 55 hrs. running time. The average speed was 32.5 m. p. h., maximum speed 65 m. p. h., maximum drawbar horsepower, 4,400; gross ton-miles in thousands, 5,181; fuel consumption per mile, 6.05 gallons.

Dynamic braking was used at four places during the run for a total of 83 miles. Maximum grades ranged from 1.27 to 3 per cent. At a speed of 20 m. p. h. the retarding effect exerted was 48,000 lb. and the horsepower 2,560. At 29 m. p. h. the corresponding figures were about 35,000 lb. and 2,730 hp.

Where the dynamic retarding brake was used, it was necessary to set the train air brakes only about one fourth as much as usual. There was no evidence of excessive wheel heating throughout the run and when stops were made after descending heavy grades, the wheels never much exceeded bare hand temperature. The total energy absorbed by the dynamic brake during its use on this run is estimated at nineteen billion seven-hundred million foot pounds, or approximately 10 per cent of the energy used to move the train during the entire run.

The locomotive is 193 ft. long from coupler to coupler, weighs 464 tons with fuel and sand and has a tractive force of 220,000 lb. at starting. The power plant consists of four 16-cylinder General Motors' two-cycle Diesel engines, a generator directly coupled to each engine and 16 traction motors of which one is located on each of the 16 axles of the eight four-wheel trucks.

Orders and Inquiries for New Equipment Placed Since the Closing of the February Issue

Locomotive Orders

Road	No. of Locos.	Type of Loco.	Builder
Chesapeake & Ohio	8	4-6-4	Baldwin Loco. Wks.
	2	4-8-4 (J3a)	Lima Loco. Wks.
Chicago, Burlington & Quincy[1]	5	360-hp. Diesel-elec.	General Electric
	6	600-hp. Diesel-elec.	
	15	1,000-hp. Diesel-elec.	Electro-Motive Corp.
	4	2,000-hp. Diesel-elec. pass.	
Denver & Rio Grande Western	5	4-6-6-4	Baldwin Loco. Wks.
Detroit, Toledo & Ironton	4	2-8-2	Lima Loco. Wks.
Maine Central	2	1,600-hp. Diesel-elec.	American Loco. Co.
		1,380-hp. Diesel-elec.	General Electric
Missouri Pacific[2]	1	1,000-hp. Diesel-elec.	Electro-Motive Corp.
	3	600-hp. Diesel-elec.	
	1	1,000-hp. Diesel-elec.	American Loco. Co.
	2	600-hp. Diesel-elec.	Baldwin Loco. Wks.
	5	360-hp. Diesel-elec.	General Electric
	3	360-hp. Diesel-elec.	Whitcomb Loco. Wks.
	3	360-hp. Diesel-elec.	Davenport-Besler Corp.
Northern Pacific	3	1,000-hp. Diesel-elec.	Electro-Motive Corp.
	2	1,000-hp. Diesel-elec.	American Loco. Co.
	2	1,000-hp. Diesel-elec.	Baldwin Loco. Wks.
Pere Marquette	12	2-8-4	Lima Loco. Wks.
Southern Pacific[3]	8	600-hp. Diesel-elec.	Electro-Motive Corp.
	5	660-hp. Diesel-elec.	American Loco. Co.
	2	600-hp. Diesel-elec.	Baldwin Loco. Wks.
Union Pacific	5[4]	4-8-8-4	American Loco. Co.

Locomotive Inquiries

Road	No. of Locos.	Type of Loco.	Builder
Grand Trunk Western	20	4-8-4	....

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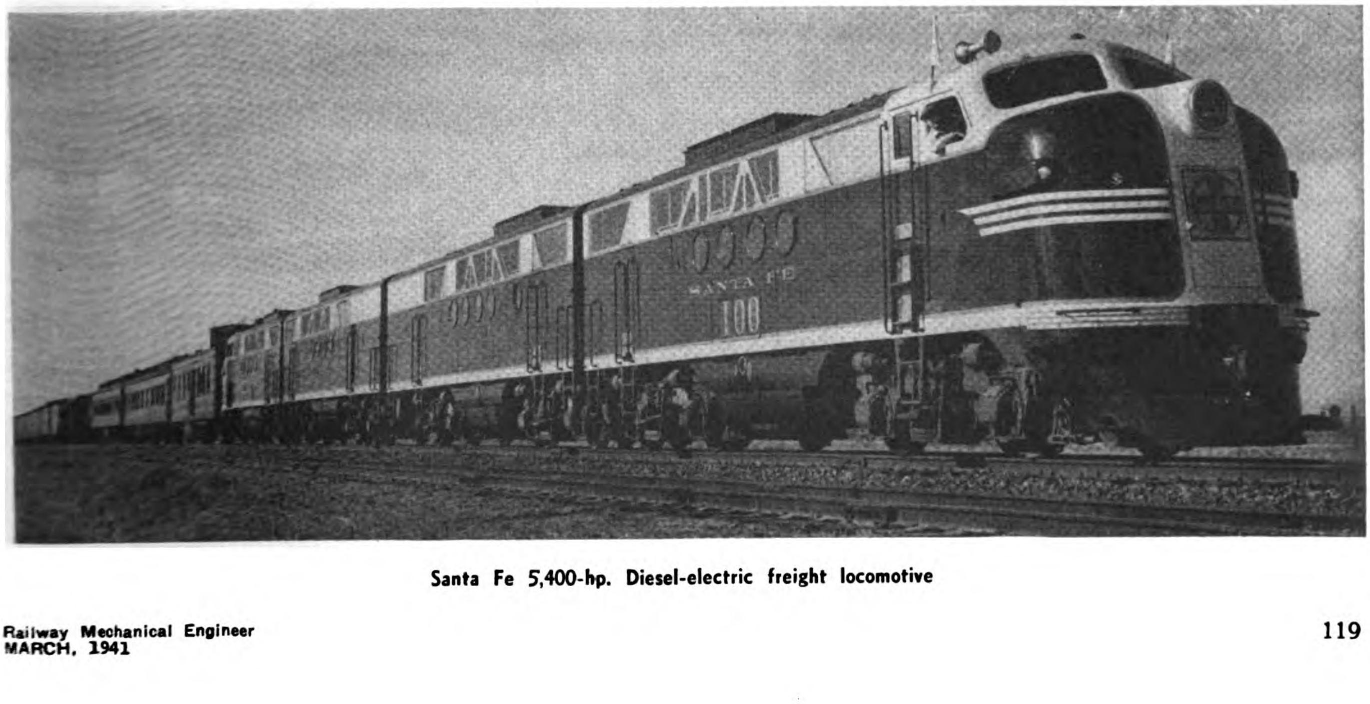
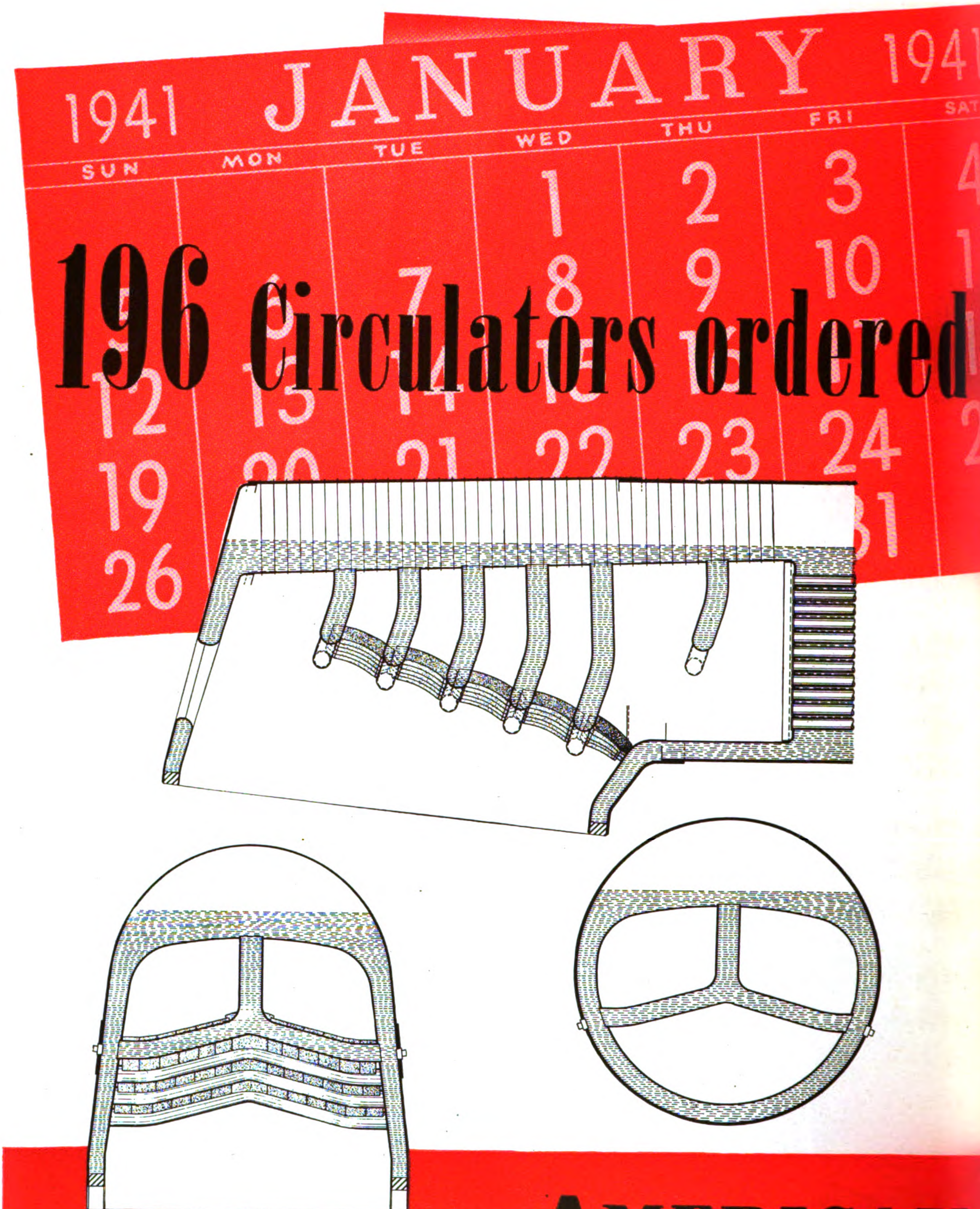


Santa Fe 5,400-hp. Diesel-electric freight locomotive

196 Circulators ordered



AMERICAN

NEW YORK **CHICAGO**

FREIGHT-CAR ORDERS

Road	No. of Cars	Type of Car	Builder
Bessemer & Lake Erie	5	90-ton hopper	Pull.-Std. Car Mfg. Co.
Chesapeake & Ohio	250	50-ton box	American Car & Fdry. Co.
	250	50-ton box	Gen. American Trans. Corp.
	250	50-ton box	Pull. Std. Car Mfg. Co.
	250	50-ton box	Mt. Vernon Car Mfg. Co.
	50	50-ton flat	Bethlehem Steel Co.
Chicago & North Western	750	50-ton gondolas	Gen. Amer. Transp. Corp.
	250	50-ton gondolas	Bethlehem Steel Co.
	200	70-ton ore	
	500	50-ton box	Pull.-Std. Car Mfg. Co.
Chicago, Burlington & Quincy	250	Ballast[1a]	Rodger Ballast Car Co.
	200	55-ton hopper	[1a] Company shops
	1,500	50-ton box	
	225	Auto parts cars	
	100	Flat	[1b] Company shops
	250	Box	
	300	Stock	[1c] Company shops
	500	Box	
Grand Trunk Western	200	70-ton gondolas	Magor Car Corp.
	100	70-ton flat	Greenville Steel Car Co.
	300	40-ton automobile	Pressed Steel Car Co.
Linde Air Products Co.	20	70-ton box	Pressed Steel Car Co.
McKeesport Connecting	100	70-ton low-side gondolas	American Car & Fdry. Co.
Missouri Pacific[2]	400	55-ton hopper	American Car & Fdry. Co.
	2	125-ton well	
	400	55-ton hopper	Mt. Vernon Car Mfg. Co.
	70	55-ton covered hopper	
	400	55-ton hopper	Bethlehem Steel Co.
Pacific Fruit Express	1,000	Refrigerator	Pacific Car & Fdry. Co.
Pere Marquette	40	Caboose	St. Louis Car Co.
St. Louis Refrig. Car Co.	35	Refrigerator	Company shops
Tennessee Coal, Iron & Railroad Co.	20	70-ton flat	Pull.-Std. Car Mfg. Co.
	20	70-ton gondolas	
	6	70-ton hot-hole	
Toronto, Hamilton & Buffalo	75	75-ton low-side gondolas	Nat'l. Steel Car Corp.
Union Pacific	300	50-ton flat	Pull.-Std. Car Mfg. Co.
	50	70-ton mill-type gondolas	
United States Navy Dept.	33	55-ton box	Greenville Steel Car Co.
United States War Dept.	20	40-ton box	Greenville Steel Car Co.
Virginian	100	50-ton box	Pressed Steel Car Co.

FREIGHT-CAR INQUIRIES

Road	No. of Cars	Type of Car	Builder
Ann Arbor	25	55-ton hopper	....
Atchison, Topeka & Santa Fe	10 or 12	50-ton box	....
Canadian National	250	70-ton hopper	....
	200	Flat	....
	150	Ballast	....
	125	80-ton ore	....
Minneapolis & St. Louis	75	Auto-box	....

PASSENGER-CAR ORDERS

Road	No. of Cars	Type of Car	Builder
Chicago, Rock Island & Pacific	3	Pass.	Edw. G. Budd Mfg. Co.
Missouri Pacific[2]	1	Rail-motor car	American Car & Fdry. Co.
New York Central	2	Mail and mail storage	[5] Edw. G. Budd Mfg. Co.
	2	Tavern-lounge-baggage	
	6	Parlor	
	4	Dining	
	16	Coaches	
	2	Obser.-buffet	

PASSENGER-CAR INQUIRIES

Road	No. of Cars	Type of Car	Builder
Chesapeake & Ohio	20	Coaches	....
Norfolk & Western	15	Coaches	....
Union Pacific	10, 15, 20 and 30	Baggage	....
	10 and 20	Mail-baggage	....
	10, 20, 25 or 30	Chair	....

[1] For the 30 Diesel-electric locomotives the C. B. & Q. plans to spend $2,437,279.

[1a] For the C. B. & Q. $6,481,000 has been allotted for this equipment.

[1b] For the Colorado & Southern. $985,000 has been allotted for this equipment.

[1c] For the Fort Worth & Denver City. $2,130,000 has been allotted for this equipment.

[2] The 18 Diesel-electric switching locomotives, the 1,272 freight cars, and the rail motor car involve an expenditure of $4,338,000.

[3] Total cost of order estimated at $900,000.

[4] In addition to 15 4-8-8-4 type locomotives ordered from the same builder as reported in the February issue.

[5] Equipment to be used for two trains to replace present Empire State Express which celebrates its fiftieth anniversary this year. To cost between $2,000,000 and $2,500,000. The new trains will be hauled by fully-streamlined steam locomotives of the Hudson-type of a design similar to that of the locomotives now hauling the Twentieth Century Limited. Details as to builder of locomotives have not as yet been made available.

Cornell Scholarships for Apprentices

THE College of Engineering, Cornell University, will receive applications until April 1 for the John McMullen industrial scholarships, which pay $400 a year for a four-year college course in engineering. Applicants must be high school graduates, must have served some time as workers of industry, preferably in a regular training course and must be recommended by their employers as men of special ability whose careers would be helped by a college course in civil, electrical, mechanical, or chemical engineering. Scholarships providing $600 per year and freedom from tuition fees for research graduate assistantships in engineering, including civil, electrical and mechanical engineering, railway engineering and theoretical and applied mechanics, have been offered by the Engineering Experiment Station of the University of Illinois, Urbana, Ill. Applications for these, however, closed on March 1.

Equipment Purchasing and Modernization Programs

Chicago & North Western.—The C. & N. W. has received permission from the district court to purchase freight and passenger equipment to cost approximately $7,500,000. The freight equipment includes 1,000 50-ton gondola cars, 500 50-ton 50-ft. box cars and 200 70-ton ore cars. The company is reported to have allocated 750 gondola cars to the General American Transportation Corporation and 250 gondola cars to the American Car and Foundry Co. The passenger equipment consists of five 2,000-hp. Diesel-electric locomotives, sixteen coaches, four combination baggage-tap room cars, three dining cars and two parlor cars. The railroad plans to use this equipment between Chicago and Wisconsin points and possibly some points in southern Minnesota.

The road has asked the Interstate Commerce Commission for authority to assume liability for $5,527,000 of equipment trust certificates, maturing in 10 equal annual installments on March 1 of each of the years from 1942 to 1951, inclusive. The proceeds will be used as part of the purchase price of the new equipment.

Chicago, Burlington & Quincy.—The C. B. & Q. will build a large number of freight cars in its own shops during 1941.

Chicago, Rock Island & Pacific.—The Rock Island has been authorized by the federal district court on February 10 to spend $7,797,058 for improvements during 1941. Of this amount, $6,583,232 is for betterments to roadway and structures, $844,576 is for improvements to equipment and $369,250 is for the purchase of new rolling stock. An allowance of $328,788 is made for improvements to shops and enginehouses and the installation of improved shop machinery and tools. The equipment program includes the purchase of 10 Diesel-electric switching locomotives, 5 of 30 tons and 5 of 44 tons, the application of roller bearings to locomotives and the enlargement of tanks and tenders. Automobile loaders will be installed in freight cars and 25 caboose cars will be built in company shops. In addition, the budget provides for the purchase of two streamline cars for overflow Rocket train travel.

Great Northern.—The Great Northern is rebuilding eight locomotives at its Hillyard, Wash., shops.

Illinois Central.—Division 4 of the Interstate Commerce Commission has amended its order in Finance Docket No. 13045 so as to permit this company to (1) substitute one 1,000-h.p. and two 2,700-h.p. Diesel-electric locomotives for three 2,000 h.p. Diesel transfer locomotives contemplated in the original order, and (2) purchase an additional 115 70-ton all-steel covered hopper cars at a cost of $447,750. The purchase of the additional cars was made possible because of price concessions given by the manufacturers on the other equipment authorized to be purchased.

Illinois Terminal.—The Illinois Terminal has asked the Interstate Commerce Commission for authority to assume liability for $560,000 of equipment trust certificates, maturing in 10 equal annual installments of $56,000 on February 15 in each of the years from 1942 to 1951, inclusive. The proceeds will be used as part payment for equipment costing a total of $706,000 and consisting of 250 50-ton all-steel box cars.

Minneapolis, St. Paul & Sault Ste. Marie.—The M., St. P. & S. S. M. has

(*Continued on page 121*)

asked the District court for permission to order 50 ballast cars from the American Car and Foundry Co., and 100 flat cars from the Pullman-Standard Car & Manufacturing Co.

New York Central.—This company has asked the Interstate Commerce Commission for authority to assume liability for $10,900,000 of equipment trust certificates, maturing in 10 equal annual installments of $1,090,000 on February 15 in each of the years from 1942 to 1951, inclusive. The proceeds will be used as part of the purchase price of new equipment costing a total of $12,173,885 and consisting of 200 70-ton steel flat cars, 600 55-ton steel box cars, 145 55-ton steel auto box cars, 100 55-ton end door box cars, 36 oil-electric switching locomotives, 95 all-steel passenger coaches, 16 all-steel passenger coaches, six all-steel parlor cars, four all-steel dining cars, two all-steel observation-buffet cars, two all-steel tavern-lounge-baggage cars, and two all-steel Railway Post Office mail and storage cars. The application points out that all the equipment enumerated following the 95 all-steel passenger coaches will be of stainless steel and will constitute equipment for two complete passenger trains.

New York, New Haven & Hartford.—The New Haven is contemplating the purchase of 1,000 box cars and 25 cabooses.

Northern Pacific.—This company has asked the Interstate Commerce Commission for authority to assume liability for $3,000,000 of equipment trust certificates, maturing in 10 equal annual installments of $300,000 on February 15 in each of the years from 1942 to 1951, inclusive. The proceeds will be used as a part of the purchase price of new equipment costing a total of $3,475,000 and consisting of eight two-cylinder 4-8-4 passenger and freight locomotives, six four-cylinder articulated 4-6-6-4 freight locomotives, three 1,000 hp. 125-ton Diesel-electric switching locomotives, two 1,000 hp. 120-ton Diesel-electric switching locomotives, and two 1,000 hp. 115-ton Diesel-electric switching locomotives.

Pacific Fruit Express.—The Pacific Fruit Express, subsidiary of the Union Pacific and Southern Pacific, has undertaken a 1941 improvement program involving an expenditure of about $15,500,000. Included is an order for 1,000 new refrigerator cars placed with the Pacific Car & Foundry Co. at a total cost of approximately $4,500,000. The company's maintenance program for the first half of 1941, involving the rebuilding and repair of more than 3,000 refrigerator cars at estimated cost of $11,000,000, provides for the reconstruction of 2,000 cars with entirely new bodies and latest type air brakes, heavy repairs to 1,000 cars and lighter repairs to others.

St. Louis-San Francisco.—The 1941 budget of the St. Louis-San Francisco calling for the expenditure of $1,114,853 has been approved by the federal district court. Of this amount $62,000 is for two 44-ton Diesel-electric switching locomotvies.

N. Y. C. 4-8-2 Locomotives—A Correction

The boilers of the New York Central 4-8-2 type Locomotives described in the January issue of the *Railway Mechanical Engineer* have Type E, 100 unit, double-loop superheaters with American throttles and not single-loop units as mentioned on page 3 of that article.

Supply Trade Notes

The Hulson Grate Company, Keokuk, Iowa, has opened a temporary demonstration office at 322 South Michigan avenue, Chicago.

◆

Milford J. Cross has been appointed representative in the western territory for the Hunt-Spiller Manufacturing Corporation, with headquarters in South Boston, Mass.

◆

James A. Curtis, sales representative of the Carnegie-Illinois Steel Corporation, with headquarters at Chicago, has been appointed sales manager of the Marquette Railway Supply Company, Chicago.

◆

Chicago Malleable Castings Company.—*W. L. Beaudway* has been appointed executive vice-president and *J. T. Llewellyn*, II, has become vice-president, of the Chicago Malleable Castings Company.

◆

Baldwin Locomotive Works.—*Stewart McNaughton* has been appointed special representative by the Baldwin Locomotive Works to act in an advisory capacity and assist the vice-president in charge of sales and the general sales manager. *C. A. Campbell*, formerly foreign sales manager, has become sales manager of the locomotive division. *C. G. Pinny*, formerly technical representative in South America, succeeds Mr. Campbell as foreign sales manager. *C. A. Bercaw* has been appointed sales manager for Diesel-electric locomotives, and *H. L. Weinberg*, chief service engineer, for Diesel-electric locomotives.

Alfred R. Walker, electrical engineer-equipment, Illinois Central, Chicago, has been appointed automotive sales engineer of the American Car and Foundry Co.,

A. R. Walker

with headquarters at New York. In his new position, Mr. Walker has to do with the development and promotion of rail-motor cars and Diesel-hauled streamline trains. Born in Pierceton, Ind., in 1892, Mr. Walker was educated at Goshen college and the University of Cincinnati, and entered railway service with the Winona Interurban during summer vacations. Following graduation, he taught high school for three years and was employed by steel mills in electrical work for seven years. In 1923, he entered the employ of the Illinois Central as a draftsman, later becoming inspector and junior and assistant engineer. In 1927 he became draftsman with Bylesby & Co., and a year later returned to the Illinois Central as electrical equipment engineer, later becoming electrical engineer-equipment. Mr. Walker served as chairman, Electrical Section, Mechanical Division, A. A. R., from 1937 to 1939.

◆

G. Donald Spackman, formerly general superintendent, has been appointed general manager of the Lukens Steel Company.

◆

A. C. Harvey Co., Allston, Mass., have been appointed jobbers of the line of Hobart multi-range arc welders to collaborate with Leo Gordon of the New England distributing office of the Hobart Brothers Company.

◆

The Superior Car Door Company Chicago, has been organized to acquire the steel car door and door fixture business of the Chicago Railway Equipment Company. The trade name "Creco" has been changed to "Superior."

◆

Earl E. Thulin, as western divisional manager, under the account of The Earl E. Thulin Company, 122 South Michigan avenue, Chicago, now represents the Joyce-Cridland Company, Dayton, Ohio, in its northwestern territory. Mr. Thulin was previously vice-president and general manager of sales of the Duff-Norton Manufacturing Company, with headquarters at Chicago. Mr. Thulin is a graduate of Lane Technical High School and Junior College, Chicago. During 1918 and 1919 he was with the Armour Car Lines Shops. In the latter year he joined the Duff-Norton sales organization.

MILLER-LEWIS RAILROAD EQUIPMENT CORP.—*John W. Miller* has been elected president, *Thomas E. Daley*, vice-president and *Francis Murphy*, secretary, of the Miller-Lewis Railroad Equipment Corporation, with headquarters in New York City. *J. F. McDonnell*, formerly connected with the New York Central, has been appointed manager of the company's Chicago branch.

◆

JOHN F. VAN NORT has been appointed sales manager, Western Division, of the Duff-Norton Manufacturing Company of

John Van Nort

Pittsburgh, Pa. Mr. Van Nort, who will be located at Chicago, was previously with a United States Steel Corporation subsidiary in various sales capacities in eastern territory.

◆

LUNKENHEIMER COMPANY.—*Harry A. Burdorf*, vice president in charge of sales, and *Frank P. Rhame*, vice president in charge of sales engineering, have been elected to the board of directors of the Lunkenheimer Company.

◆

THE OKONITE COMPANY, Passaic, N. J., on January 15, 1941, have opened a district office at 1212 Comer building, Birmingham, Ala. Dewey A. White, formerly sales engineer in the Atlanta office, and 17 years with Okonite, has been appointed manager of the new branch. The south central territory will include Tennessee, Alabama, Mississippi and Louisiana, and Mr. White will represent The Okonite Company, the Okonite-Callender Cable Co., Inc., and the Hazard Insulated Wire Works Division. The south Atlantic territory (North Carolina, South Carolina, Georgia and Florida) will continue to be covered by George N. Brown, manager of the Atlanta, Ga. office, 1606 Rhodes-Haverty building. The St. Louis, Mo., office of Okonite has been moved from the Ambassador building to larger quarters at 1406 Shell building. Robert E. Sontag remains in charge as manager.

◆

THE DEVILBISS COMPANY, manufacturers of spray-painting equipment, exhaust systems, air compressors and hose, have opened a sales and service office at 1280 West Washington Boulevard, Chicago.

◆

W. A. CATHER has been placed in charge of market research and related activities for the Seamless Steel Tube Institute, 3510 Gulf, Pittsburgh, Pa. Mr. Cather will operate out of the Institute's office in Pittsburgh and the offices of the Michel-Cather organization at 2 Park avenue, New York.

◆

W. E. HEDGCOCK, acting head of the Sales department of American Car and Foundry Co. since March 29, 1940, has been appointed vice-president in charge of sales, with full authority as to the direction of the affairs and of the personnel of that department.

Obituary

JOHN ROBERTS, retired engineer of the transportation department of the General Electric Company, Schenectady, N. Y., died on January 28 at his home in Schenectady at the age of 69 after a short illness.

◆

GEORGE N. DEGUIRE, assistant to the president and a director of the Locomotive Firebox Company, died on January 26 at his home in New Rochelle, N. Y. , at the age of 56. At the time of his death he was also a member of the executive staff of The Oxweld Railroad Service Company (unit of the Union Carbide & Carbon Corp.); president, Ajax Hand Brake Company; and vice-president and a director of the O. C. Duryea Corporation. His headquarters were at New York. Mr. DeGuire was born in Appleton, Wis., in 1884, and was educated in high school and in special business courses. In 1900 he entered railroad service with the Chicago & North Western as a fireman at the age of sixteen, later becoming locomotive engineer and special member of the mechanical department, successively. In 1916, he was assigned to special duties in the Interstate Commerce Commission. In 1918 Mr. De-

George N. DeGuire

Guire became assistant manager of the Department of Equipment, United States Railroad Administration, later becoming manager, which post he held until 1923.

◆

R. N. BAKER, assistant manager of the railway department of the Chicago office of the Okonite Company, died January 3 after a brief illness. He was 69 years old.

Personal Mention

General

JOHN BURNS, works manager of the Canadian Pacific at Montreal, Que., has retired because of ill health. Mr. Burns has been works manager for more than 21 years.

W. S. MOSELY, mechanical engineer of the Clinchfield, with headquarters at Erwin, Tenn., has been appointed also assistant to the general manager.

M. R. BENSON, master mechanic on the Michigan Central at St. Thomas, Ont., has been appointed to the newly created position of assistant superintendent of equipment.

FRANK KENNETH MITCHELL, assistant to general superintendent motive power of the New York Central, has been promoted to assistant general superintendent motive power and rolling stock, with headquarters as before at New York.

BERNARD FAUGHMAN, general freight car foreman at the Angus shops, of the Canadian Pacific, has been promoted to assistant works manager.

A. L. WRIGHT, superintendent of shops of the Boston & Albany at West Springfield, Mass., has been appointed assistant to general superintendent of motive power of the New York Central system, with headquarters at New York.

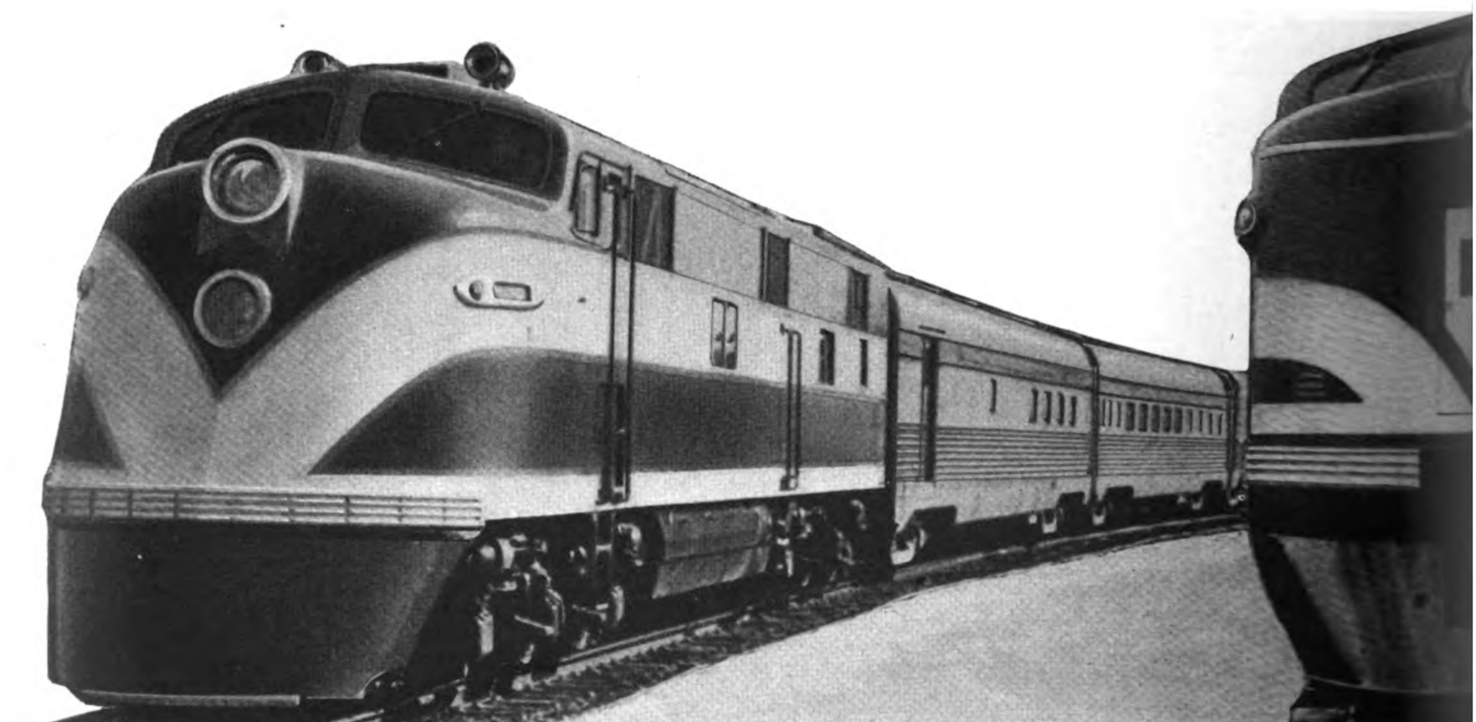
HARRY W. JONES general superintendent of the Eastern Pennsylvania division at Harrisburg, Pa., has become appointed chief of motive power of the Pennsylvania at Philadelphia, Pa. Mr. Jones was born at Northumberland, Pa., on December 30, 1884, and entered railway service with the Pennsylvania as a machinist apprentice in the Sunbury, Pa., shops in 1903. In 1908, he was appointed assistant enginehouse foreman at Sunbury, becoming enginehouse foreman at Renovo, Pa., in 1911 and shop inspector in the office of the superintendent of motive power at Williamsport, Pa., in 1912. In 1913, he was appointed general foreman of the Olean (Pa.) shops, which position he held until 1915 when he was appointed shop inspector in the office of the general superintendent of motive power at Altoona, Pa. Mr. Jones was appointed assistant master mechanic at Wilmington,

(Continued on page 123)

70 Railroads and Heavy Industries

THE acid test of any development is its demonstrated adaptability, reliability and economy. Success is measured by growth. The rapid progress made by EMC Diesels as reflected in the ever increasing number of users is most significant. In six years over 480 EMC Switchers and 140 EMC units of road power have been placed in service by 70 railroads and industrial companies throughout the country.

What finer tribute to EMC Diesel leadership in reliability, economy, high availability, safety, increased passenger traffic and lower operating costs.



ELECTRO-MOTIVE

SUBSIDIARY OF GENERAL MOTORS

Complete Dieselization Most Economical

IN line with the established policy to pre-prove thoroughly each new type of equipment before offering it to the railroads, Electro-Motive Corporation built a 5400 hp. Diesel locomotive for test in freight service. This locomotive operated over 80,000 miles in actual service on 20 leading railroads from coast to coast, both as a 2700 hp. single unit and as a 5400 hp. double unit.

The marked increases in tonnage handled on existing schedules, the ability to shorten schedules and decrease the number of locomotives required, and other outstanding advantages and economies, proved conclusively that the EMC Diesel Freight Locomotive, in addition to EMC Diesels for switching, transfer and passenger service, now makes possible the complete Dieselization of any railroad.

Del., in 1917 and served as master mechanic at Sunbury and Renovo from 1918 until 1921, when he was transferred to the Juniata shops at Altoona. In 1929 he went

Harry W. Jones

to Pittsburgh, Pa., as superintendent motive power, Western Pennsylvania division, and in 1930 became general superintendent motive power of the Central region at Pittsburgh, going to Indianapolis, Ind., in 1933 as general superintendent of the Southwestern division. In 1937 he was transferred to the Eastern Pennsylvania division at Harrisburg, Pa.

R. G. Bennett, general superintendent of motive power of the Eastern region of the Pennsylvania, has been appointed assistant chief of motive power, with headquarters as before at Philadelphia, Pa. Mr. Bennett was born on March 31, 1882, at Brighton, England, and was graduated from Purdue University in 1908 with the degree of bachelor of science in mechanical engineering, receiving his mechanical engineering degree in 1915. He entered railway service in January, 1900, as a machinist apprentice on the Pennsylvania at Erie, Pa., and completed his apprenticeship in 1904 at the Renovo (Pa.) shops. While attending college, Mr. Bennett was employed during summer months as a ma-

Robert George Bennett

chinist, draftsman and inspector on the Pennsylvania. In November, 1908, he was appointed motive power inspector of the Monongahela division, holding that position until March, 1912, when he became rodman in the maintenance of way department, Pittsburgh division. He was appointed inspector in the test department in March, 1913, in charge of the locomotive test plant at Altoona, Pa. In May, 1916, Mr. Bennett became assistant master mechanic on the Cumberland Valley (part of the Pennsylvania) at Chambersburg, Pa., and in February, 1917, was appointed assistant engineer of motive power of the Central division of the Pennsylvania at Williamsport, Pa. He was appointed master mechanic at Sunbury, Pa., in July, 1917, and in May, 1918, was transferred to the Pittsburgh (Pa.) division. He was promoted to superintendent of motive power of the Central Pennsylvania division at Williamsport, Pa., in December, 1919, and in June, 1924, was transferred to the Eastern Ohio division at Pittsburgh. In April, 1925, he became general superintendent of motive power of the Southwestern region, at St. Louis, Mo., and in June, 1925, was transferred to the Eastern region.

Warren Robert Elsey, mechanical engineer of the Pennsylvania, at Philadelphia, Pa., has been appointed general superintendent of motive power, Eastern region, with headquarters at Philadelphia. Mr.

Warren Robert Elsey

Elsey was born on April 1, 1892, at Pittsburgh, Pa., and was graduated from the Carnegie Institute of Technology in 1910. He entered railway service on September 26, 1911, as a draftsman on the Pennsylvania at Pittsburgh and served in this capacity until March 16, 1916, when he became piecework inspector at Shire Oaks, Pa. On July 16, 1917, he was appointed shop inspector, with headquarters at South Pittsburgh, Pa., becoming assistant master mechanic at Canton, Ohio, on April 1, 1920, and motive power inspector of the Western Pennsylvania division on March 1, 1921. Mr. Elsey was appointed assistant master mechanic at Conemaugh, Pa., on February 1, 1923. On February 1, 1928, he was promoted to the position of master mechanic at Baltimore, Md. From January to December, 1929, he was acting superintendent of floating equipment at Jersey City, N. J., then becoming superintendent of floating equipment there. He was appointed mechanical engineer at Philadelphia on October 1, 1936.

C. K. Steins, assistant chief of motive power-locomotive of the Pennsylvania, at Philadelphia, Pa., has been appointed mechanical engineer with headquarters at Philadelphia. Mr. Steins was born at East Orange, N. J., on February 21, 1891, and

Carleton K. Steins

was graduated from the Stevens Institute of Technology in 1913 with a degree in mechanical engineering. He entered railway service in July, 1913, as special apprentice in the motive power department of the Pennsylvania and was furloughed for military service in 1917, serving overseas with the 19th Engineers as first lieutenant. In May, 1919, he returned to the Pennsylvania as assistant master mechanic, New York division, and subsequently became assistant engineer of motive power at New York, Harrisburg, Pa., and Philadelphia. In 1928, Mr. Steins was appointed master mechanic at Indianapolis, Ind., and in 1929 was transferred to Wilmington, Del. In April, 1937, he became assistant chief of motive power—locomotive.

H. L. Nancarrow, superintendent of the Pittsburgh division of the Pennsylvania, with headquarters at Pittsburgh, Pa., has been promoted to general superintendent of the Lake division, with headquarters at Cleveland, Ohio. Mr. Nancarrow was born on January 13, 1897, at Jersey Shore, Pa. He received his mechanical engineer-

Harry L. Nancarrow

ing degree from Bucknell University in 1920, and entered railway service on October 7, 1920, as a draftsman in the office of the superintendent of motive power of

the Pennsylvania at Philadelphia, Pa. On March 14, 1921, he was appointed special apprentice at the Altoona machine shops, becoming inspector of motive power there on April 17, 1924. He was appointed gang foreman on the Cleveland division on September 1, 1924, and assistant enginehouse foreman on February 10, 1926. On March 1, 1927, he became assistant master mechanic on the Akron division, being promoted to master mechanic of the Erie & Ashtabula division on May 16, 1928. On January 1, 1929, he was transferred to the Baltimore division and later to the Philadelphia Terminal division. On September 16, 1936, he became superintendent of the Logansport division, being transferred to the Buffalo division on January 16, 1938. He became superintendent passenger transportation of the Eastern Region at Philadelphia, on May 1, 1939, and superintendent of the Pittsburgh division at Pittsburgh, Pa., on January 16, 1940.

Edward Greig Bowie, who has been appointed superintendent of the motive power and car departments of the Western lines, with headquarters at Winnipeg, Man., as announced in the February issue, was born in Winnipeg on August 20, 1892, and

Edward Greig Bowie

entered railway service on June 25, 1907, as a clerk in the traffic department of the Canadian Pacific. On March 15, 1909, he became a machinist apprentice and from April 7, 1913, to March 15, 1914, served also as an assistant dynamometer-car operator. On the latter date he became a machinist at Winnipeg and later served successively as a clerk in the mechanical department at Calgary, Alta., iron machinist in the car department at Montreal, Que., inspector in the locomotive department, machinist and dynamometer-car operator. On December 10, 1915, he was promoted to the position of assistant foreman in the locomotive department at Ottawa, Ont., and on May 18, 1916, was transferred to Outremont, Que. Mr. Bowie became locomotive foreman at Sherbrooke, Que., on November 9, 1916, was transferred to Smith's Falls, Ont., on March 1, 1917, and advanced to general foreman at McAdam, N. B., on June 1, 1918. On April 1, 1920, he was appointed division master mechanic at Brownville Junction, Me., and later was transferred to Schreiber, Ont., and London, Ont. On January 1, 1928, he became district master mechanic, with headquarters at North Bay, Ont., later being transferred successively to Moose Jaw, Sask., and Vancouver, B. C. Mr. Bowie was appointed works manager of the Ogden shops at Calgary on July 1, 1936, and assistant superintendent of motive power on October 16, 1937.

H. R. Naylor, assistant works manager, car department, Canadian Pacific, with headquarters at Montreal, Que., has been promoted to works manager, Angus shops with headquarters at Montreal, Que. Mr.

H. R. Naylor

Naylor was born in Hull, England, and served an apprenticeship with the North Eastern Railway. He joined the Canadian Pacific in 1907 as patternmaker in the Angus shops and later worked in the drawing office. In 1911 he became steam-heat inspector and in 1912 went to West Toronto as general foreman of the passenger car shops, returning to Montreal in 1913 as divisional car foreman of the eastern division, now Quebec district. Mr. Naylor returned to the Angus shops in 1915 as supervisor of piecework and in 1918 was attached to the chief mechanical engineer's staff at Windsor Station. He was appointed general car foreman of freight car work in 1919 and assistant works manager, car shops, in 1920.

Obituary

Eliot Sumner, who retired in 1937 as assistant to general superintendent motive power of the Eastern region of the Pennsylvania at Philadelphia, Pa., died of a heart attack on January 29 at his home in Essex Falls, N. J., at the age of 67. Mr. Sumner was born on October 18, 1873, at New Haven, Conn., and received his education at Yale University. He entered railway service in 1896 as a machinist apprentice at the Altoona, Pa., shops of the Pennsylvania, later serving until 1901 as an inspector, Philadelphia division. In 1901, he was appointed assistant master mechanic, Middle and Western divisions and in 1902, assistant engineer of motive power, Buffalo and Allegheny Valley division; from 1903 until 1907 he was in the office of general superintendent of motive power. In 1907 he was appointed master mechanic, Baltimore division; in 1911, master mechanic, Williamsport division; in December, 1913, master mechanic, West Philadelphia shops. In July, 1916, superintendent of motive power, Williamsport, Pa., in May, 1918, superintendent of motive power, New Jersey division, with headquarters at New York and in 1928, assistant to general sup-

Eliot Sumner

erintendent of motive power of the Eastern region at Philadelphia. Mr. Sumner was a member of the Executive Committee of the American Society of Mechanical Engineers, from 1927 to 1930 and chairman in 1931. From 1928 to 1930 he was president of the New York Railroad Club.

Ray M. Brown, assistant to general superintendent of motive power of the New York Central, at New York, who died on January 17, as announced in the February issue, was born on April 9, 1879, at Ashtabula, Ohio. He entered the service of the Lake Shore & Michigan Southern (now New York Central) as machinist apprentice at Cleveland, Ohio, in 1899, and subsequently served on that road as draftsman, apprentice instructor, chief draftsman and assistant engineer of motive power. From 1915 to 1924, Mr. Brown was assistant engineer and engineer of motive power

Ray M. Brown

of the New York Central at New York, then becoming assistant superintendent motive power. In 1926, he was appointed superintendent of motive power, and in 1934 became assistant to the general superintendent of motive power, with supervision over the general locomotive repair shops.

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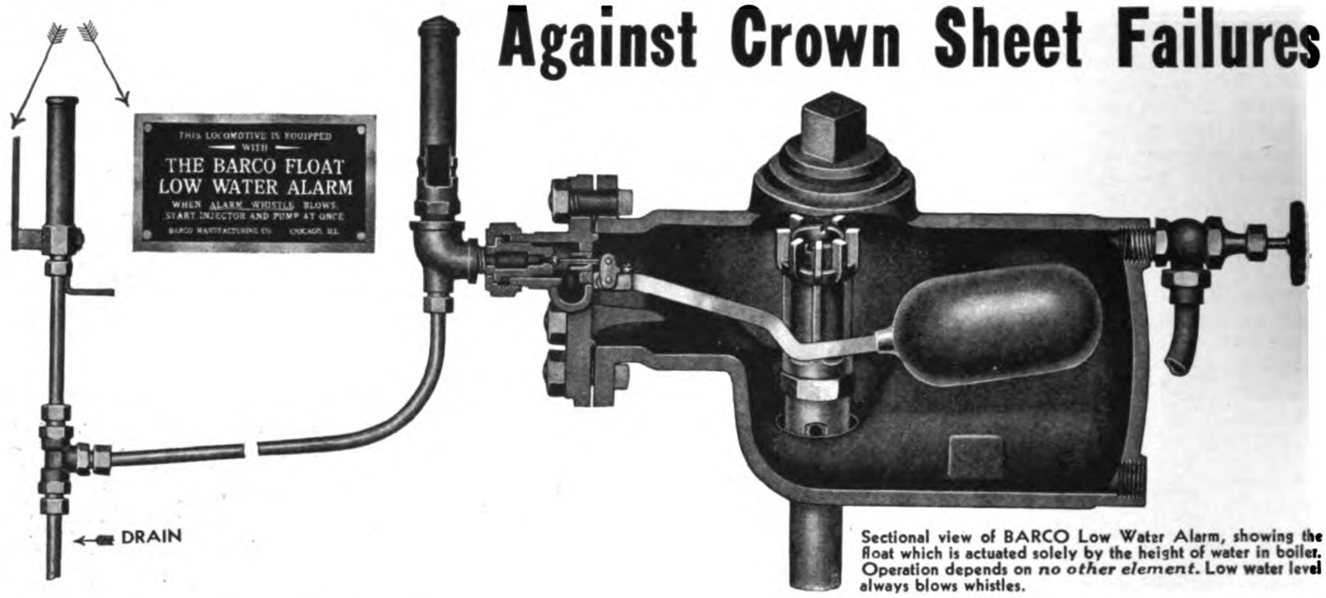
ADDED INSURANCE

Against Crown Sheet Failures

CAB PLATE



Sectional view of BARCO Low Water Alarm, showing the float which is actuated solely by the height of water in boiler. Operation depends on *no other element*. Low water level always blows whistles.

BARCO *Two-Whistle*

LOW WATER ALARM

The spectacular advancement that has been made, during the last five years, toward higher speeds and super-locomotives, has led to an increased demand for dependable devices that contribute to added safety.

The BARCO Low Water Alarm is a most logical choice for the protection that is required against crown sheet failures due to low water in locomotive boilers.

The small whistle in the cab and the large whistle on the low water alarm located on top of the boiler insure simultaneous warning to the engine crews and to the terminal crews within fifty seconds after the water reaches the predetermined low point. Actuated solely by the height of water in the boiler the alarm and the elapsed time is uniform.

The price of the BARCO Low Water Alarm installed is ridiculously low with respect to the protection it affords to the investment in motive power, crew and traveling public.

BARCO PROTECTION Costs Only .0014 of Average Locomotive Cost

BARCO MANUFACTURING COMPANY

1808 W. Winnemac Ave. NOT INCORPORATED Chicago, Illinois

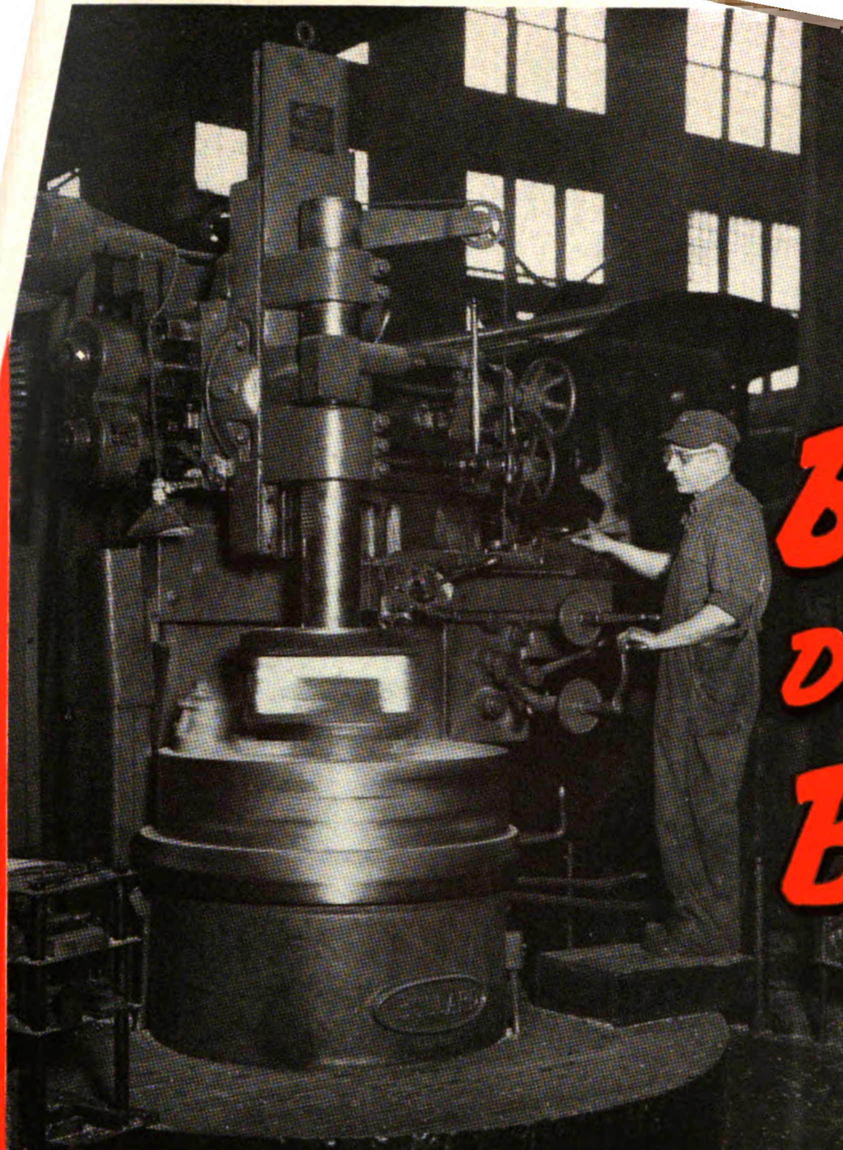
In Canada THE HOLDEN COMPANY, LTD.

Montreal — Moncton — Toronto — Winnipeg — Vancouver

Railway Mechanical Engineer

April
1941

FOUNDED IN 1832



RAILWAY MECHANICAL ENGINEER

Founded in 1832 as the American Rail-Road Journal

With which are also incorporated the National Car Builder, American Engineer and Railroad Journal, and Railway Master Mechanic. Name Registered, U. S. Patent Office.

April, 1941

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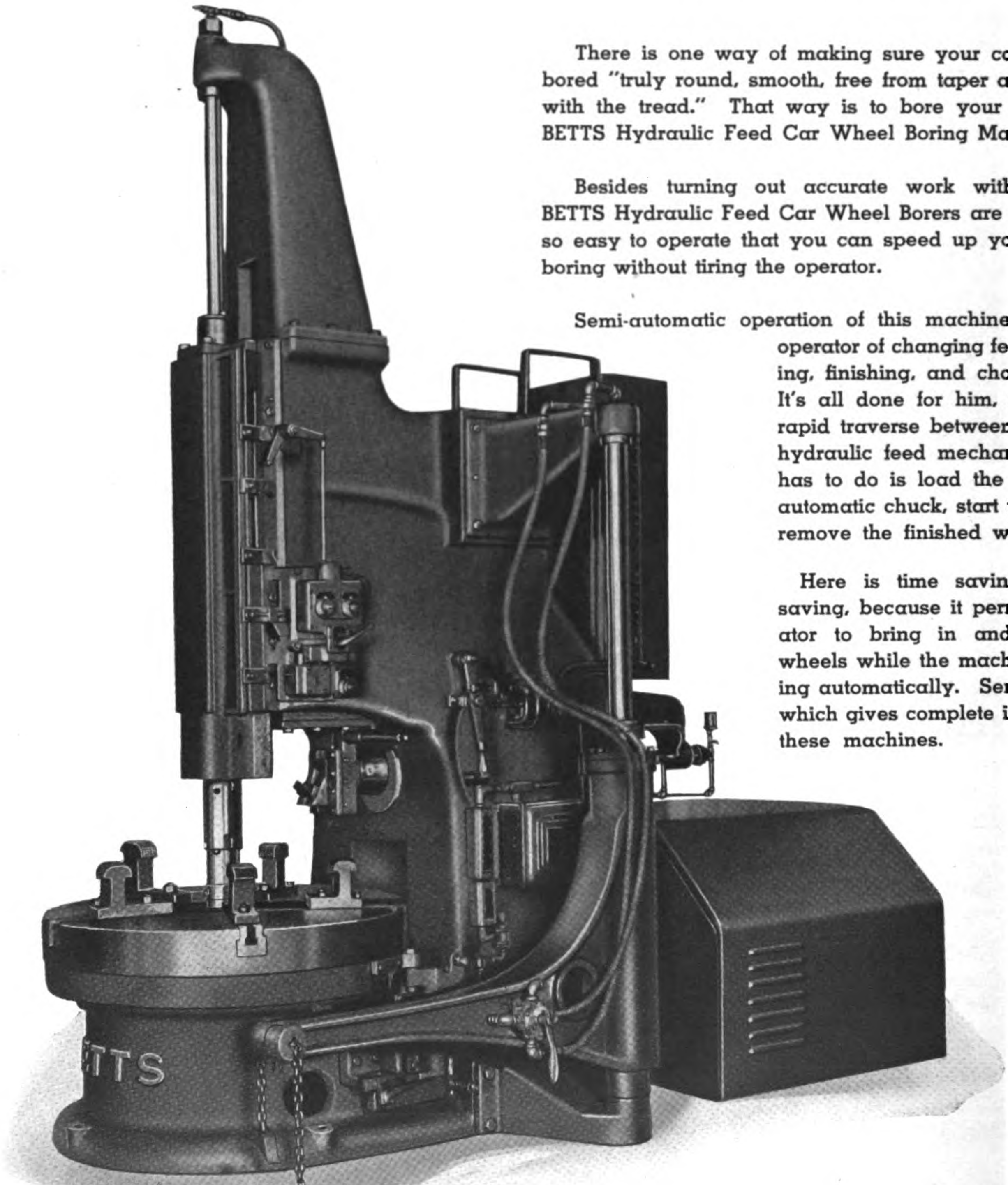


RAILWAY MECHANICAL ENGINEER

Pacific type locomotive with

Poppet Valves Tested on P. R. R.

Franklin system of steam distribution installed on a class K4s locomotive demonstrates high drawbar capacity at high speeds in road tests and regular passenger-train service

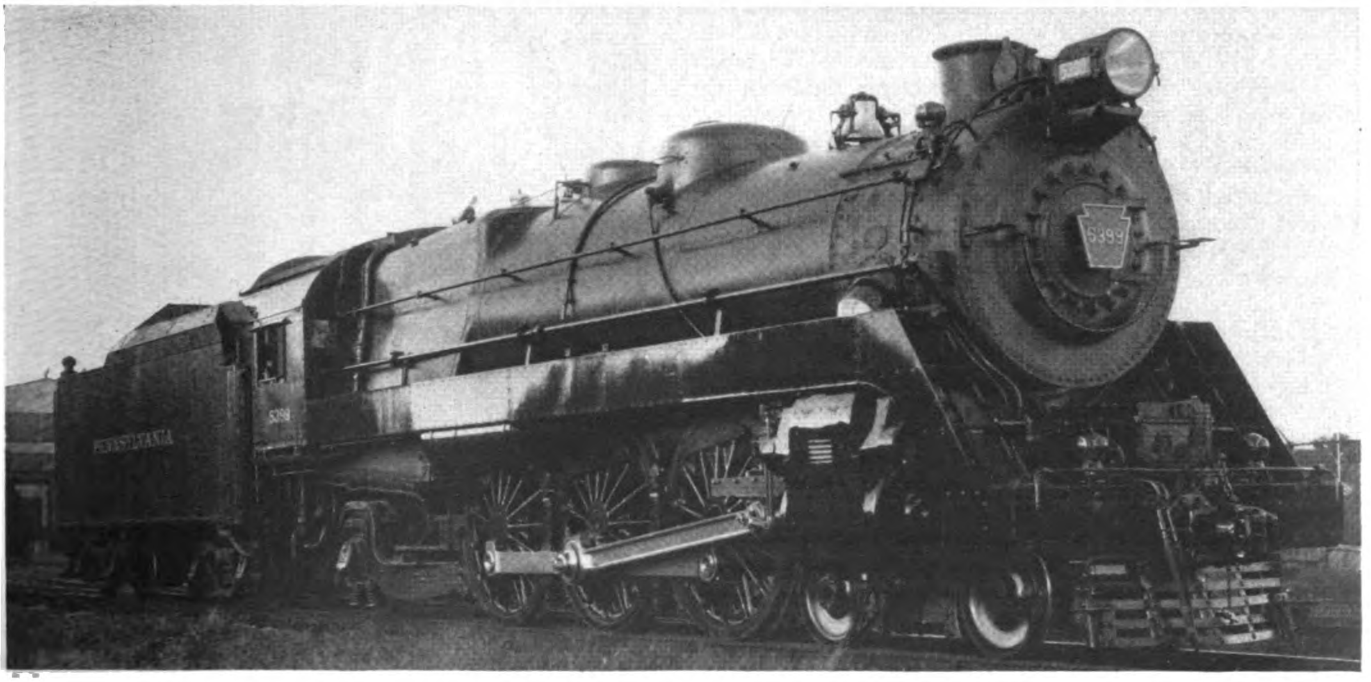
A Pennsylvania Railroad Class K4s Pacific type locomotive, No. 5399, was equipped with the Franklin Railway Supply Company's system of steam distribution with "O. C." poppet valves* during the summer of 1939. Following the completion of the installation at the plant of the Lima Locomotive Works, Inc., Lima, Ohio, the locomotive was placed in service on the Ft. Wayne division where it handled passenger trains between Crestline, Ohio, and Fort Wayne, Ind., and Crestline and Chicago, with periodical trips to Lima for inspection, for about one year. In that time it ran approximately 57,000 miles.

After the first month of road service the locomotive was subjected to a series of road tests with a dynamometer car duplicating the 1000-ton passenger-train tests conducted by the Mechanical Division of the Association of American Railroads in October 1938.† Additional tests with the poppet-valve locomotive were also run with trains both lighter and heavier than the 1,000-ton train of the A. A. R. tests.

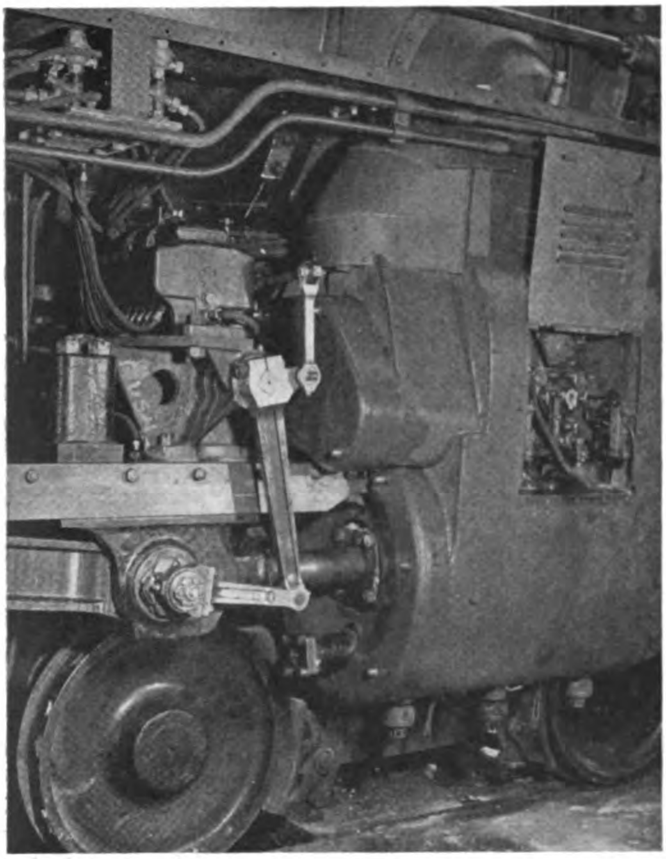
In the road tests the poppet-valve locomotive No. 5399 developed a maximum adjusted drawbar horsepower of 2,980 at 60 to 65 miles an hour, and the curve is almost flat from 50 to 75 miles an hour. Compared with the drawbar horsepower recorded in the A. A. R. tests, the poppet-valve locomotive showed increases of 24.2 per cent at 60 miles an hour, 32.7 per cent at 70 miles an hour, and 44 per cent at 80 miles an hour. The relatively high capacity of the locomotive at high speeds was also clearly evident from its performance in regular service. It repeatedly handled trains alone which are normally double-headed, frequently making better than scheduled running time. While most of the improvement in the performance of locomotive 5399 should be credited to the poppet valves, the increased steam-chest volume and free exhaust passages with which the engine is equipped, contributed to some extent.

* For a description of this system and its development see the *Railway Mechanical Engineer*, September, 1939, page 349.

† A summary of the results of these tests was published in the *Railway Mechanical Engineer*, May, 1939, page 175.



Locomotive No. 5399 after the installation of the Franklin system of steam distribution with O. C. poppet valves



The valve-gear rocker shaft and crosshead connection—The end of the cam box can be seen through opening in cylinder jacket

In only two cases during the year of road service before the locomotive went to the test plant did it cause train delays chargeable to the steam distribution system. One was caused by a stuck intake valve and the other by a broken valve-gear-box drive pin. There was one other case of a valve sticking, but no train delay was caused. During the year five exhaust valves cracked and had to be replaced. In nearly every case this was done without holding the engine out of service. On one occasion repairs were also required to the cam-box oil pump and the locomotive was held out of service for repairs to one of the rocker shafts which transmit the drive from the crosshead to the valve-gear box.

To improve the quality of the valves they are now being machined from alloy-steel forgings instead of the commercial bar stock originally used. Changes in the valve-stem guides have also effected marked improvement in their resistance to wear, which is one of the causes of valve wear and of the cracking of the exhaust valves.

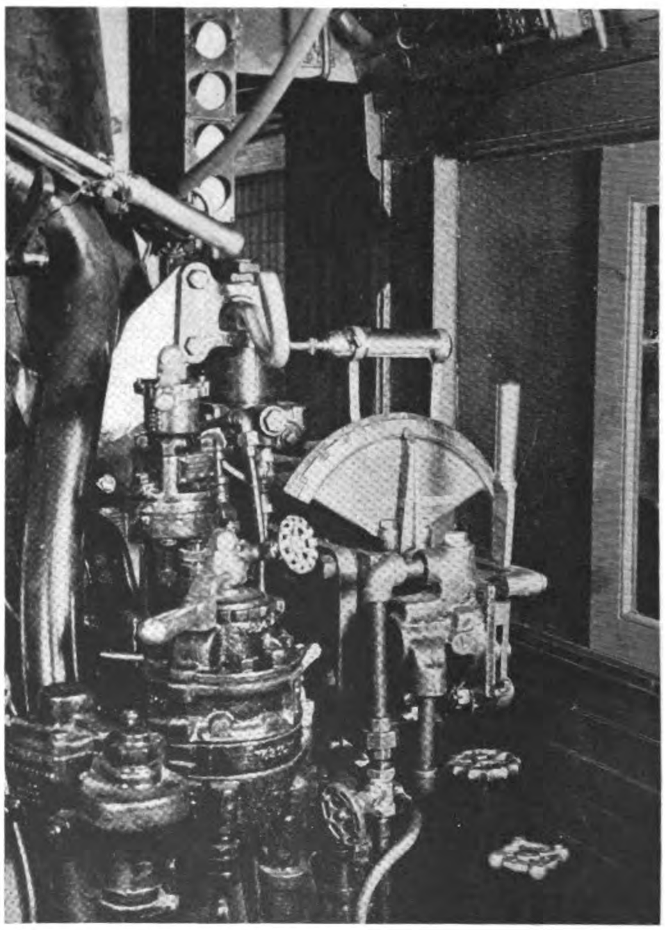
During the year the gear box and cam boxes were subjected to periodic inspection. No indication of wear was evident at any of these inspections. As mileage accumulated the cam surfaces and the link and link-block bearing surfaces assumed only a higher degree of polish, reflecting the effectiveness of the lubrication as well as the resistance of the materials in these parts to wear.

Indicator records of the pressure variations in the steam pipe and steam chest on one side of the locomotive suggested that restrictions to the flow of steam through the original Type A superheater were causing appreciable reductions in cylinder mean effective pressure at high speeds. To improve this condition the locomotive was taken out of service during the summer of 1940 to be fitted with a new superheater header, including a multiple throttle, and with single-pass Type ASW units. It was then subjected to an extensive series of plant tests at Altoona.

During the test-plant runs locomotive No. 5399 developed over 4,000 i. hp. on several occasions. At 75 miles an hour and about 30 per cent cut-off the cylinder output was 4,267 i. hp. and the drawbar horsepower, 3,862. This is one indicated horsepower for each 79.5 lb. of engine weight. The cylinders used 69,430 lb. of

Principal Dimensions and Weights of Pennsylvania K4s Locomotive No. 5399

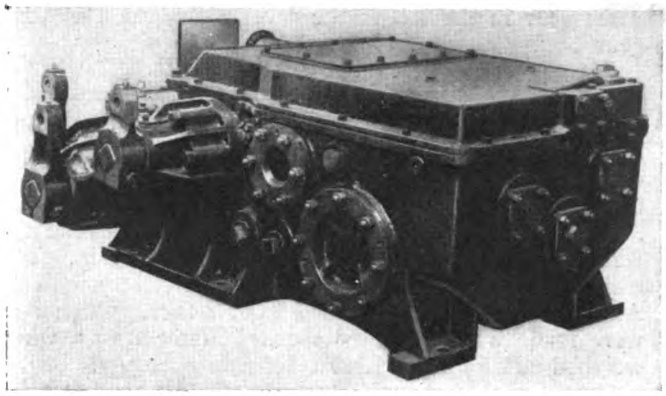
Builder	Pennsylvania
Type of locomotive	4-6-2
Date built	1924
Rated tractive force, lb.	44,460
Weights in working order, lb.:	
On drivers	208,800
Total engine	330,800
Engine and tender two-thirds loaded	506,366
Driving wheels, diameter new, in.	80
Cylinders, number, diameter and stroke, in.	2—27 x 28
Steam pressure, lb. per sq. in.	205
Grate area, sq. ft.	70
Heating surface (total evaporative and superheater), sq. ft.	4,984
Number and diameter (in.) of poppet valves for each cylinder:	
Intake	4—6
Exhaust	4—7
Maximum valve lift (all valves), in.	1
Average clearance volume, per cent	8.41
Steam-chest volume (including steam pipe), per cent of cylinder volume:	
With poppet valves	73
Standard K4s	36.3



The reverse gear in the cab

steam per hour. At 100 miles an hour and about 30 per cent cut-off the locomotive developed 4,099 i. hp. and 3,547 db. hp.; the cylinders used 76,208 lb. of steam per hour.

With an output of 70,000 lb. of steam per hour the pressure drop between the boiler and steam chest, through the new superheater was only 11 lb. per sq. in.



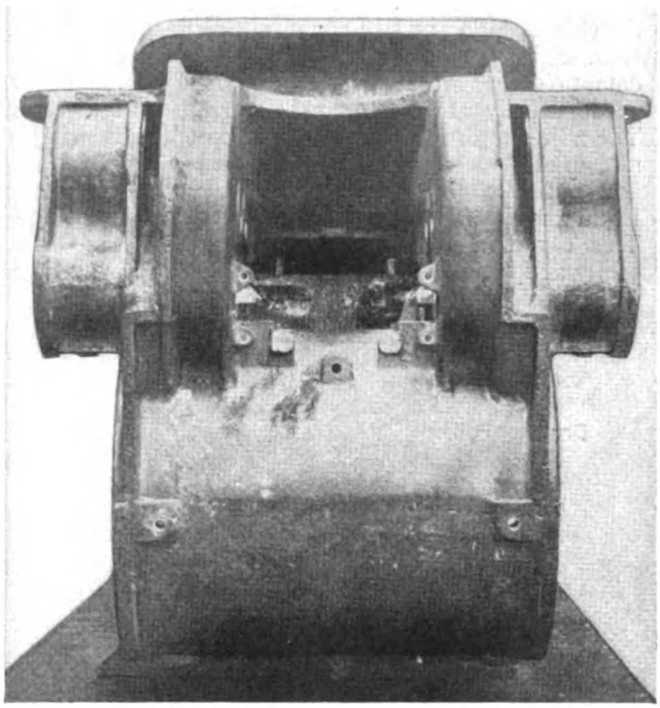
The valve-gear box

The Test Locomotive

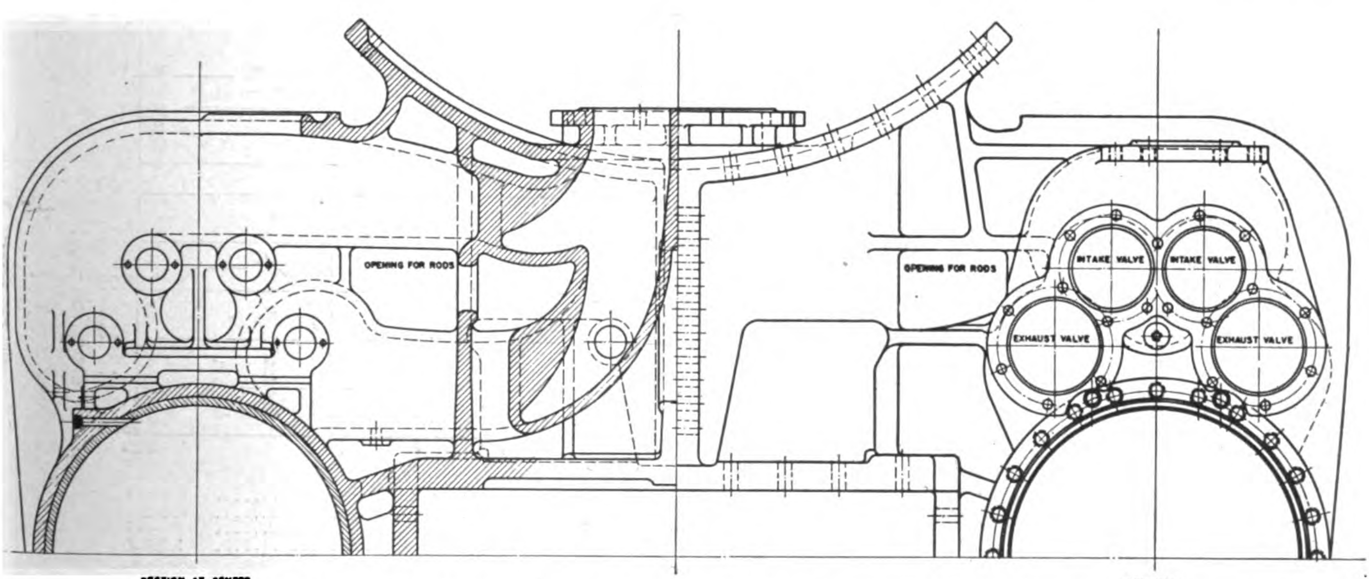
The principal characteristics of locomotive No. 5399, after the conversion are shown in the table. As installed on this locomotive, the Franklin system of steam distribution consists of four parts. These are the steam chests in which are fitted the poppet valves and which are cast integral with the cylinders, one at each end of each cylinder; the cam boxes, one mounted on each cylinder between the steam chests; the valve-gear box, mounted on the deck in front of the cylinders, and the power reverse gear.

The principal changes required in the locomotive were the replacement of the original cylinders with new castings incorporating the poppet-valve steam chests, and lengthening the front deck by adding a 9½-in. pilot beam. This was fabricated from steel plates, channels and angles by welding. The Walschaert valve gear was removed and a rocker shaft, supported from the engine frame, placed immediately back of each cylinder. The arm on the outer end of this shaft is driven from the crosshead. The inside arm drives the valve gear through a rod connection to the valve-gear box. Large openings through the exhaust-passage connections between the steam chests and the saddle are provided for these rods. The two oscillating cam shafts in each cam box are driven by rods which extend back from the oscillating-shaft arms of the valve-gear box, one of which furnishes the drive for the intake valves and the other for the exhaust valves. There are two 6-in. intake valves and two 7-in. exhaust valves in each of the four steam chests.

The valve motion is reversed by a train of gears in the valve-gear box driven by a shaft extending through the rear wall of the box. The reverse gear in the cab consists of an air-motor drive, controlled by a small lever, and a quadrant-type cut-off indicator. A shaft with suitable bevel-gear connections leads from the re-



Outside elevation of the poppet-valve cylinder for locomotive No. 5399



End elevation section through the poppet-valve cylinders, showing the exhaust passages

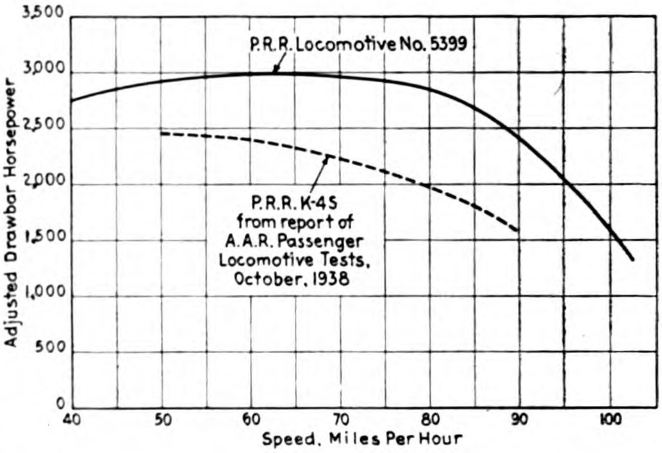
verse gear in the cab to the reverse shaft of the valve-gear box.

The Road Tests

The road tests were run on the Fort Wayne division between Fort Wayne Junction, Ind., and Valparaiso, a distance of 103 miles. The test train was made up of the same Pennsylvania dynamometer car used in the A. A. R. tests and Class P-70 coaches. A round trip was made with 15 of these coaches in the train. This train weighed 997.8 tons and compared closely with the A. A. R. train, which weighed 1,005.2 tons. Other runs were made with 9 and 18 coaches in the trains, which weighed 624 tons and 1,177.6 tons, respectively.

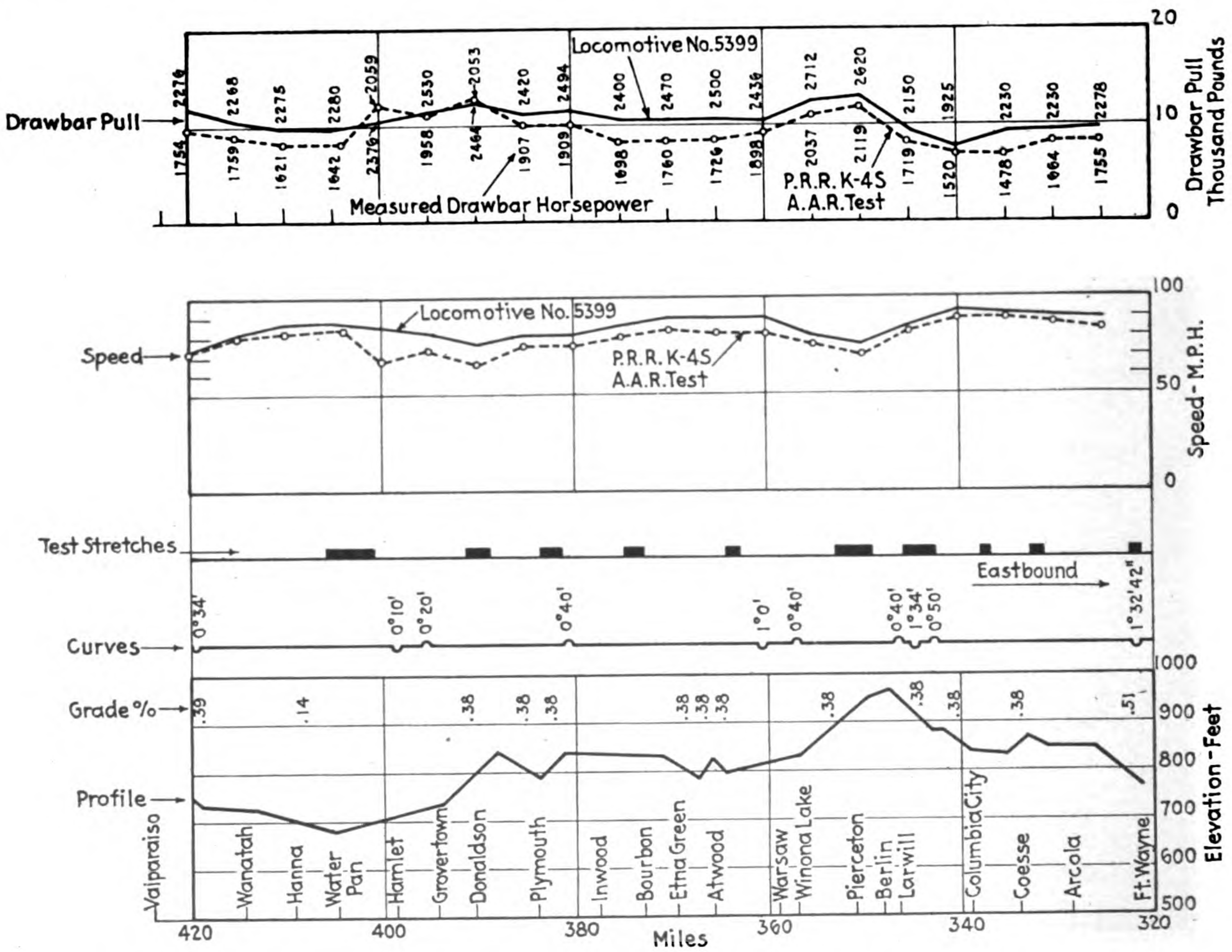
On the thousand-ton tests the speeds and the drawbar horsepower were, in general, higher than were developed in the A. A. R. tests. The comparison for the eastbound trip is shown in one of the charts.

One of the graphs shows the adjusted drawbar horsepower of engine No. 5399 in comparison with that of the class K4s locomotive employed in the A. A. R. tests. Both curves are calculated in the same manner from data taken when the train was moving on a uniform grade usually at least 4,000 ft. longer than the train. The adjusted drawbar pull is obtained by correcting the measured drawbar pull for the effect of grade and of acceleration of the weight of the locomotive and tender. From this the adjusted drawbar horsepower is calculated. This curve indicates clearly the great increase in capacity at speeds of over 50 miles an hour, compared with a locomotive of the same type equipped with piston valves and standard steam passages. The locomotive is capable of doing useful work at speeds above 100 miles an hour.



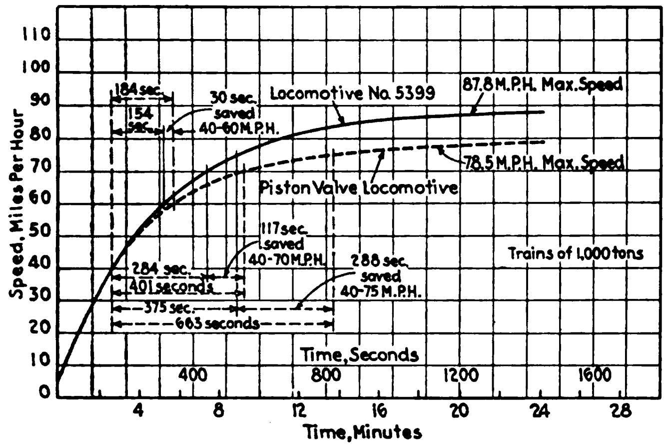
Adjusted drawbar horsepower developed in road tests by Pennsylvania Locomotive No. 5399

The high capacity of engine No. 5399 is also indicated by its acceleration performance. A comparison was made between the highest rate of acceleration of the 1,005.2-ton A. A. R. test train and that effected by engine No. 5399 with a 1,177.6-ton train. Both values were taken from the same piece of track. Corrected for level track,

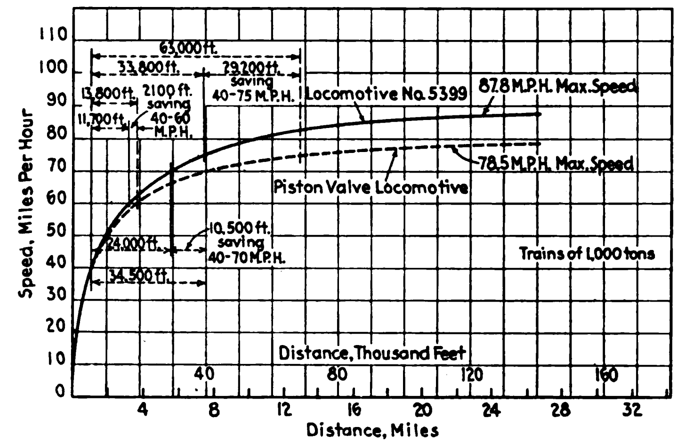


No. 5399:		Running cut-offs during test, per cent	28-50
Weight of train behind locomotive, tons	997.8	Temperature of steam in steam pipe, deg. F.	651,685
Average speed, m.p.h.	83.0	Area of nozzle, sq. in.	45
Maximum speed (from dynamometer chart), m.p.h.	94.7	Weight of A. A. R. test train, tons	1,005.2

Typical road-test performance of Pennsylvania locomotive No. 5399, equipped with the Franklin steam distribution system, compared with the Pennsylvania K4s Pacific Type locomotive used in the A. A. R. tests of 1938



Speed-time curves during acceleration of 1,000-ton trains on level track—Locomotive No. 5399 compared with a standard class K4s

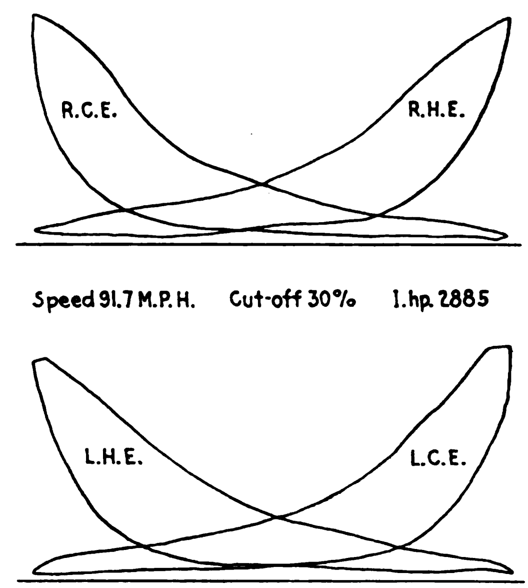


Speed-distance curves during acceleration of 1,000-ton trains on level track—Locomotive No. 5399 compared with a standard class K4s

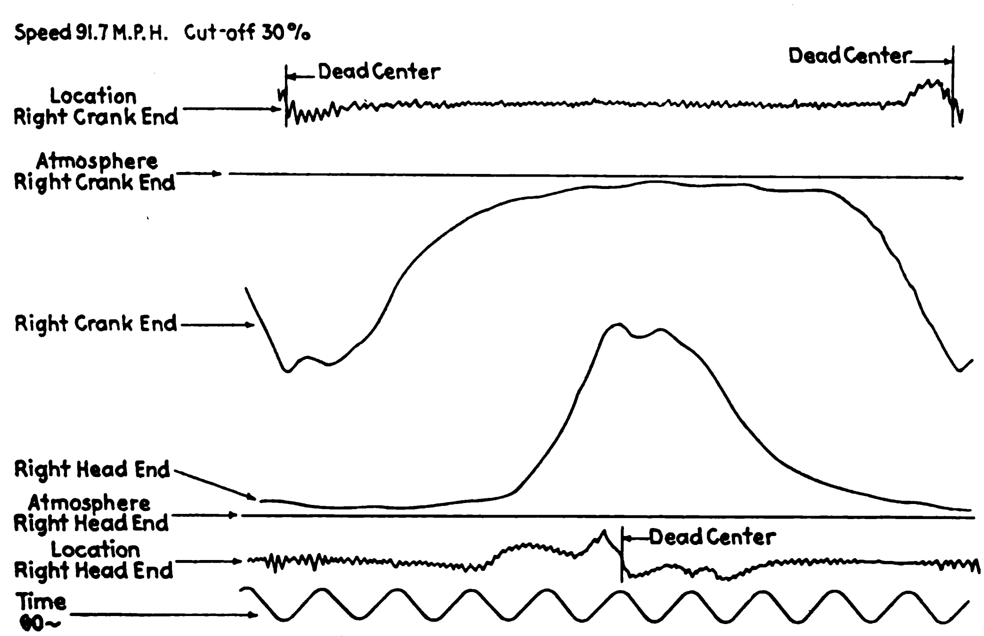
locomotive No. 5399 required only 255 sec. to accelerate the heavier train from 50 to 70 miles an hour, while the same change in velocity of the lighter train required 280 sec. Two of the graphs show speed-time and speed-distance curves, respectively, corrected for trains of 1,000 tons each. On this basis, the reductions effected by locomotive No. 5399 amount to 4 min. 48 sec. in the time and of 5.5 miles in the distance required to accelerate from 40 to 75 miles an hour.

Indicator cards were taken on all dynamometer tests from both ends of both cylinders at test sections of track. For the eastbound runs the test sections are indicated on the test-run chart. On a run handling a regular passenger train additional cards were taken from the right cylinder, and the pressures in the right steam chest and the right steam pipe at the superheater header outlet were recorded at the same time that the cards were being taken.

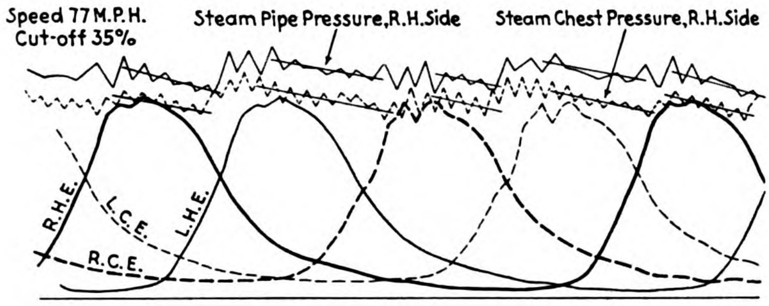
All of these data were taken with special indicators manufactured by the General Electric Company. The deflections of the diaphragm in this indicator are recorded photographically with an oscillograph. A typical record produced by the oscillograph is shown in one of the drawings. The indicator deflections are converted to pressure by the use of appropriate calibration factors.



A typical electric indicator card at high speed taken from Locomotive No. 5399 during the road tests



The original record from which the typical indicator card was developed



Marked fluctuations in steam-pipe and steam-chest pressure on one side of the locomotive are effected by the admission to the cylinders on both sides of the locomotive

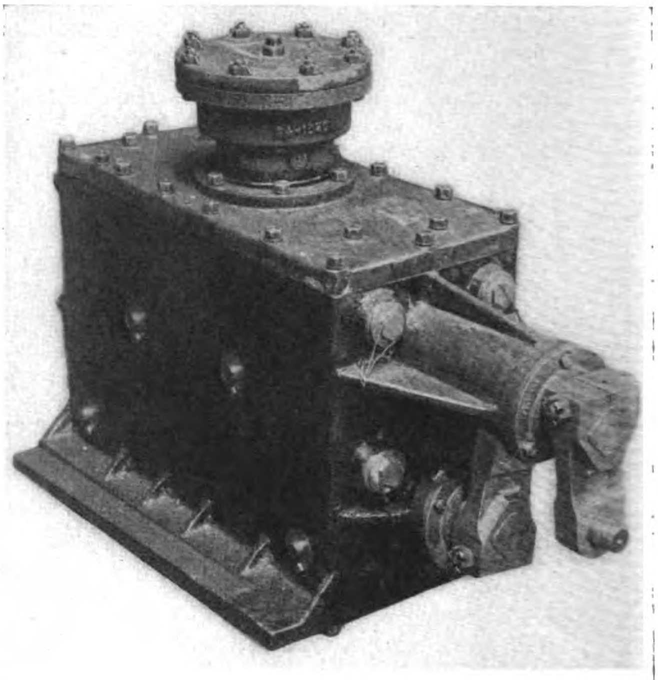
Some of the records were also converted to conventional cards. A sample card taken at 91.7 miles an hour with a cut-off of 30 per cent is reproduced here. It is notable for its well-defined expansion curve, late release, flat exhaust line, and relatively short compression.

Reference has already been made to the high tractive capacity at high speeds demonstrated by engine No. 5399 during its regular service on the Fort Wayne division. The minimum cut-offs employed during each run varied all the way from 17½ per cent to 45 per cent. During the early part of the service period minimum cut-offs of 25 per cent were recorded for a considerable number of runs and shorter cut-offs for a few. Minimums of 30 and 35 per cent were reported most frequently.

There were many instances in which this locomotive demonstrated its capacity to make better than running time with trains of 13 cars on the fastest schedules of a very fast division. Two such instances of especial interest may be cited.

On November 5, 1939, engine No. 5399 pulled train No. 49 (The General) from Crestline to Chicago. The train consisted of 13 cars and weighed about 914 tons. It left Crestline nine minutes late, stopped at Fort Wayne for seven minutes instead of the scheduled five minutes, and passed Liverpool (the end of the Fort Wayne division) 11 min. ahead of time. For the 131.7 miles from Crestline to Fort Wayne the average speed was 67 miles an hour. For the 117.8 miles from Fort Wayne to Liverpool the average speed was 77.7 miles an hour. From Warsaw to Liverpool, 78.8 miles, the speed averaged 84.43 miles an hour. These speeds are all based on train-sheet time reports.

On November 15, 1939, engine No. 5399 pulled a special train from Chicago to Crestline against a heavy east wind. This train consisted of 13 cars and had an approximate weight of 1,150 tons. It made the 148 miles to Fort Wayne in 2 hr. 13 min., the exact running time of No. 28 (the Broadway Limited). Its only advantage was not making the regular Englewood stop. From Fort Wayne to Crestline the 131.7 miles were made in two hours, which is 5 min. less than the running time of No. 28. From Chicago to Fort Wayne the average speed was 66.8 miles an hour. From Fort Wayne to Crestline the average was 65.8 miles an hour. In both cases slow-downs for speed restrictions and to scoop water are included, and in the latter case there was also a stop for coal.



One of the cam boxes

[An account of the test-plant tests will be printed in a later issue.—Editor.]

* * *

Seventy-five car freight train of the Southern Pacific in the Truckee River Canyon, Sierra Nevada Mountains of California

C. & I. M. caboose after extensive reconstruction

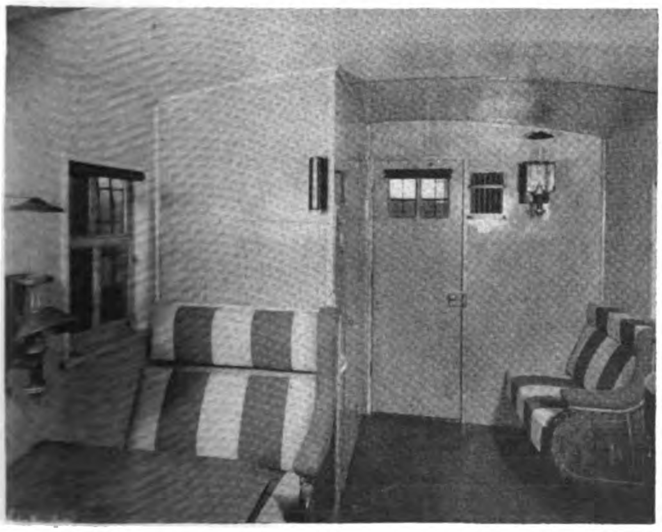
C. & I. M. Rebuilt Caboose

Unusual facilities for crew comfort include four lower-berth sections, complete refrigerator, and two-burner oil stove for cooking, in addition to oil-burning heater

THE Chicago & Illinois Midland recently rebuilt and modernized a caboose which possesses a number of unique comfort and convenience facilities for trainmen, as well as including all of the safety features generally recognized by railroads as standard practice in caboose-car construction. The car was turned out of the company shops, Taylorville, Ill., in November, 1940, and has given exceptionally satisfactory service since that time.

In reconditioning the C. & I. M. caboose car, designated No. 65, no change was made in trucks, underframe or superstructure framing, as all these parts were found in first-class condition requiring only a few minor repairs. The exterior wood siding was entirely removed and replaced with ⅛-in. steel sheathing on the sides and ends of car. The interior lining and ceiling of the car body and the entire interior of the cupola was replaced with three-ply Douglas-fir plywood.

The sides, ends, roof, cupola and flooring were completely insulated with hair felt, paper backed. The entire interior, such as cupboards, seats, etc., was removed from the car and the interior rebuilt, using a different floor plan, as shown in the drawing.



The seats on the floor of the car are each supplied with a folding table and a wall-bracket oil lamp

The floor of this car above the wood consists of a red composition plastic ½ in. thick, laid over the wooden floor. A dry hopper, wash stand, water tank and water cooler, with outlet to interior of car has been built in one corner of the car in a space 3 ft. by 4 ft. 6 in., and in this compartment provisions were made for storing of markers when not in use. Across the car a side seat fully upholstered, 3 ft. 4½ in. long, is installed for the use of brakemen.

In the opposite end of the car, in one corner, are three trainmen's lockers, extending the full height of the car, approximately 3 ft. deep and 17 in. wide. Across the car from these lockers a built-in ice box occupies the full height of car. This is made in three sections, the bottom section for ice, the middle section for perishables, and the top section for the storage of canned goods and supplies used by train crews for the furnishing of their own meals while on the road or away from the home terminal. Immediately next to the ice box in a space 8 ft. 1⅛ in. by 2 ft. 2½ in. wide is a work table, a sink and water tank for the use of the crew in preparing their meal. Underneath, in this space, are built-in, enclosed cupboards for the storage of cooking utensils, the cooking being done on a flat top, oil burning stove, which has two burners.

Heating of the car is taken care of by an oil-burning

Looking from the cupola toward the end of the caboose—At the end of the car are lockers on the left and the refrigerator on the right

heater, burning fuel oil, which has given, during the extreme cold weather, very satisfactory service.

The cupola seats, two on each side, have been reduced in width to 2 ft. 7¾ in., and so arranged as to make up into two bunks similar in design to berths found in standard sleeping cars. The cupola was moved to the center of the car and it was necessary to lengthen the cupola approximately 2 in., in order to have a standard length of 6 ft. 1 in. available for making up a berth.

Seats are placed on the floor of the car, adjacent to the cupola, at diagonally opposite ends, and are so arranged that the two sections may be made up into bunks

General Dimensions of Rebuilt C. & I. M. Caboose

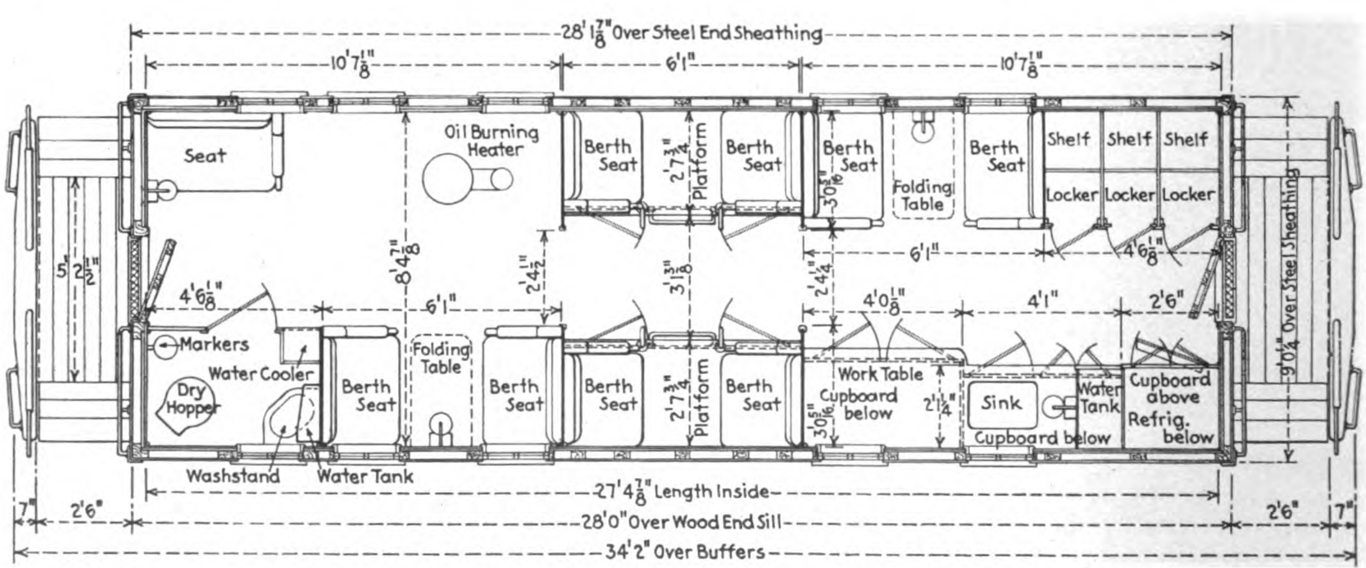
	Ft.	In.
Length over body end posts	28	0
Length over coupler pulling face	36	8
Length over striking castings	34	2
Center to center of king pins	19	0
Length inside	27	5⅜
Width over side sills	9	0
Width inside lining	8	5⅜
Width at eaves	9	5½
Rail to center of drawbar	2	10½
Rail to bottom of side sill	3	5½
Bottom of sill to top of side plate	8	½
Rail to top of cupola roof	14	7⁹/₁₆
Rail to top of cupola signal lamp	15	11¹/₁₆
Height inside at center in clear	7	3¹⁵/₁₆
Truck wheel base	5	6
Journals	4	¼ in. by 8
Track gage	4	8½

for the use of the train crew at night. In each of the sections on the floor of the car, a folding table is supplied for the conductor, so arranged that he may use either section and ride facing the direction in which the train is moving.

Kitchen facilities include a refrigerator, a sink with running water, cupboards, work table and oil stove

The entire space under the cupola platform on both sides of the car is taken up by enclosed cupboards. One

(*Continued on page 140*)



Arrangement of the facilities in the modernized C. & I. M. caboose

In Cajon Pass, Calif.

Santa Fe Installs High-Capacity

Diesel-Freight Locomotive

Built by the Electro-Motive Corporation, the locomotive has 5,400 engine horsepower, a starting tractive force of 220,000 lb., and a top speed of 80 m. p. h. — Dynamic brake designed to dissipate over 4,700 hp. through air-cooled grids

THE first Diesel-electric freight locomotive on the Atchison, Topeka & Santa Fe was installed in main-line service on a test run which began at Kansas City (Argentine), Kan., on February 8 and ended at Los Angeles, Calif., on February 15. The locomotive, No. 100, was designed and built by the Electro-Motive Corporation, General Motors subsidiary, La Grange, Ill. It was tested with a dynamometer car on its first eastbound trip as well as on the westbound trip. The locomotive has produced highly satisfactory results, and the Santa Fe now has three more of the same size and type on order from the same builder.

Besides being the first Diesel locomotive in regular main-line freight service and the first equipped with electric retarding brakes, the Santa Fe 5,400-hp. Diesel Locomotive, No. 100, is said to have greater tonnage-moving capacity than any steam locomotive ever placed on the rails. The table shows its starting tractive force of 220,000 lb. for example, substantially exceeds that developed by its nearest competitor, the Virginian 2-10-10-2 compound locomotive, built in 1918, even when the latter was operated for short intervals with single steam expansion. As compared with the Northern Pacific 2-8-8-4 single-expansion steam locomotive, built in 1929, the starting tractive force of the Diesel is 66,700 lb. greater, the total engine weight about 100 tons less and the length 68 ft. more.

In another table and on the drawing are given the principal dimensions and general arrangement of equipment in locomotive No. 100. The locomotive, with a rated top speed of 80 m. p. h., is designed so that it may be operated from control stations in the streamline nose of either end, thus eliminating the necessity of turning. The locomotive consists of four sections, hinged at three points to facilitate proper weight distribution, permit the locomotive to negotiate curves with ease, avoid high rail stresses and increase wheel life. This design also permits free movement of crew members through the locomotive with unusually easy access for all service or repair operations.

The design is further distinguished by a short truck rigid wheel base with all of its advantages. Each section has two four-wheel trucks and power is thus applied at 32 wheel points. The Edgewater heat-treated rolled-steel wheels are 40 in. in diameter. The trucks are designed to negotiate 23-deg. curves, or a 250-ft. radius, with 2¼ in. free lateral motion in the truck bolster and ⅜ in. in the journal boxes.

General Construction of the Locomotive Sections

The locomotive body framing, made of welded carbon-molybdenum steel, simulates bridge construction and is designed for high strength per unit of weight. Side paneling applied to the frame members is not included in stress calculations. At the cab end, collision framing above the platform consists of a combination of posts, plates and braces. Two large front posts are securely fastened to the platform and a deep anti-telescoping plate, the ends of which tie into heavy diagonal braces, are anchored in the side framing. The elevated cab floor

supports, front bulkhead and the rear partition members are all arranged to give added strength to the front end structure. Roof hatches are installed for easy installation and removal of engines, generators and other equipment.

The outside finish consists of panels of ⅜-in. plywood, completely covered with suitable gage Galvannealed steel with soldered edges to protect against moisture. This material is used because of its light weight and flat surface. Bolt holes not being permitted, these panels are clamped in position by the use of battens. Space between panels for batten bolts and to permit uneven expansion of materials is filled with a plastic asphalt putty. The streamline front end is covered with 12-gage steel which is welded to the framing and assists as a stress member.

The underframe construction is supplemented by a welded ½-in. floor plate which acts as a foundation for anti-skid runways. Body center plates are Grade-B steel castings, welded to the body-bolster assembly. Wear plates are applied to the bottom and outside surfaces.

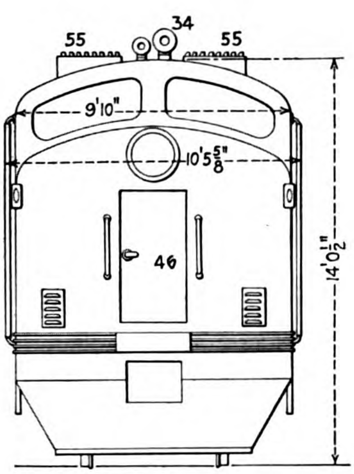
The locomotive control cab is located approximately over the front bolster. The cab floor is elevated above the locomotive platform to give maximum vision. The cab is accessible through a door on each side and from the engine compartment by means of a three-step stairway. The sloping V-shape front windows are equipped with automatic windshield wipers, defroster and sun visors. Drop sash side-windows are included. Swivel, adjustable, upholstered seats, with back and arm rests are installed at both the engineman's and the fireman's position. Cabs are soundproofed against both engine-room and track noises. Safety plate glass is used in all windows and doors. The front windshield glass is 9/16 in. thick and all other ¼ in.

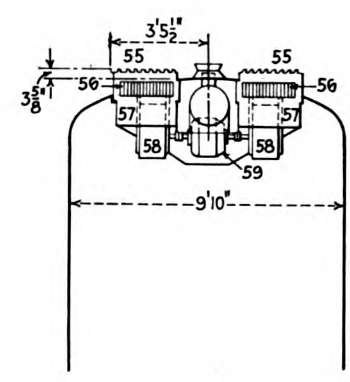
Front and rear couplers are A. A. R. Type-E with

Santa Fe 5,400-Hp. Diesel Freight Locomotive Compared With Largest Steam Power Previously Built

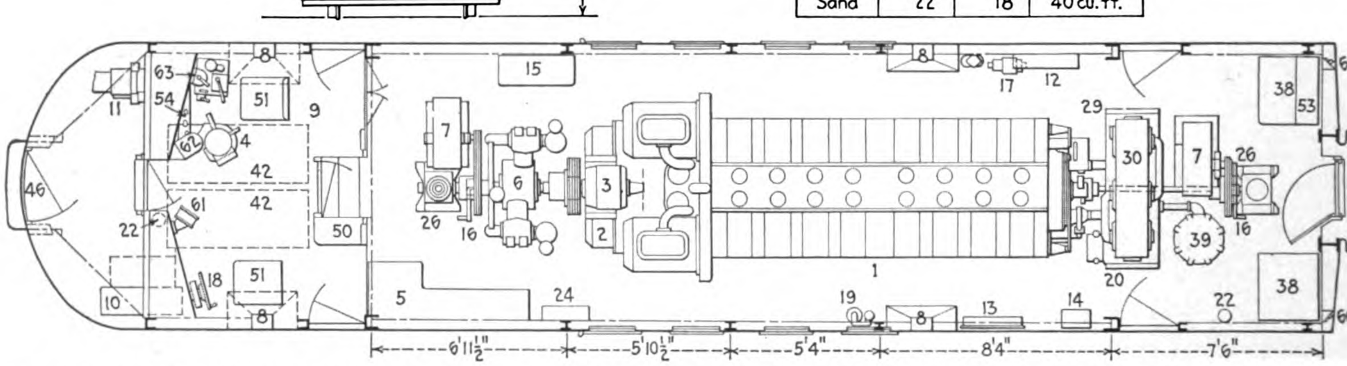
	Length, ft.	Weight, lb.	Starting tractive force, lb.
5400-hp. Diesel locomotive (1940)	193	923,600	220,000
N. P. 2-8-8-4 simple steam (1929)	125	1,116,000	153,300*
Virginian 2-10-10-2 compound (1918)	97	898,300	176,600†
Erie 2-8-8-8-2 triplex (1914)	90	853,000	160,000‡

* Includes 13,400 lb. for booster.
† Working simple; 147,200 lb., compound.
‡ Maximum tractive force, working compound.





Supplies	No.1 Sec.	No.2 Sec.	Total
Fuel	1,200	1,200	2,400 Gal.
Sand	22	18	40 cu. ft.



1—Engines EMC Model 16-567—1,350 hp.
2—Main Generator EMC Model D-8
3—Auxiliary Generator
4—Controller
5—High-Voltage Cabinet
6—Air Compressor
7—Traction Motor Blower
8—Sand Boxes
9—Operator's Cab
10—Train-Control Equipment
11—Distributing Valve 8-A
12—Engine Control and Instrument Panel
13—Hostler's Control
14—Load Regulator
15—Low Voltage Cabinet
16—Fan Drive Clutch
17—Engine Fuel Pump
18—Hand Brake
19—Fuel Tank Vent with Flame Arrester
20—Lubricating Oil Tank
21—Air Valve
22—Fire Extinguisher
23—Ballast
24—Resistor Cabinet
25—Toilet
26—Fan Drive
27—Fans (26 in.)
28—Shutters
29—Engine Cooling Water Tank
30—Oil Cooler
31—Radiator
32—Exhaust Manifold
33—Air Intake-Cooling System
34—Horn
35—Sand Filler
36—Air Cleaner and Silencer
37—Fuel Filler
38—Batteries
39—Lub. Oil Filter
40—Fuel Tank—1,200 gal.
41—Generator Service Door
42—Main Air Reservoir
43—Air Intake—Engine Room
44—Air Filters
45—Fuel Tank Gauge
46—Door
47—Classification Light
48—Classification Flag Bracket
49—Blue Flag Bracket
50—Locker
51—Seat
52—Air-Brake Equipment
53—Distribution Cabinet
54—Instrument Panel
55—Louvers
56—Grids
57—Air Duct
58—Blower
59—Motor
60—Flag and Signal Lamp Bracket
61—Speedometer
62—Shift Indicator
63—Dynamic Brake Control

Floor plan, end elevation, and cross-section of the No. 1 Section of the Santa Fe 5,400-hp. Diesel-electric freight locomotive

special heavy shanks. The locomotive sections are permanently connected with metallic-hose connections. National Malleable Type M-380 rubber draft gears are used at the front and rear. The drawbar carrier is spring-supported. The coupler connection is designed for a swing of 17 deg. and has an 11-in. knuckle. The removable pilot is made of 3/16-in. steel plate, substantially braced both laterally and longitudinally. A 7-in. rolled-section anticlimber is applied to the front end of the platform.

The Power Trucks

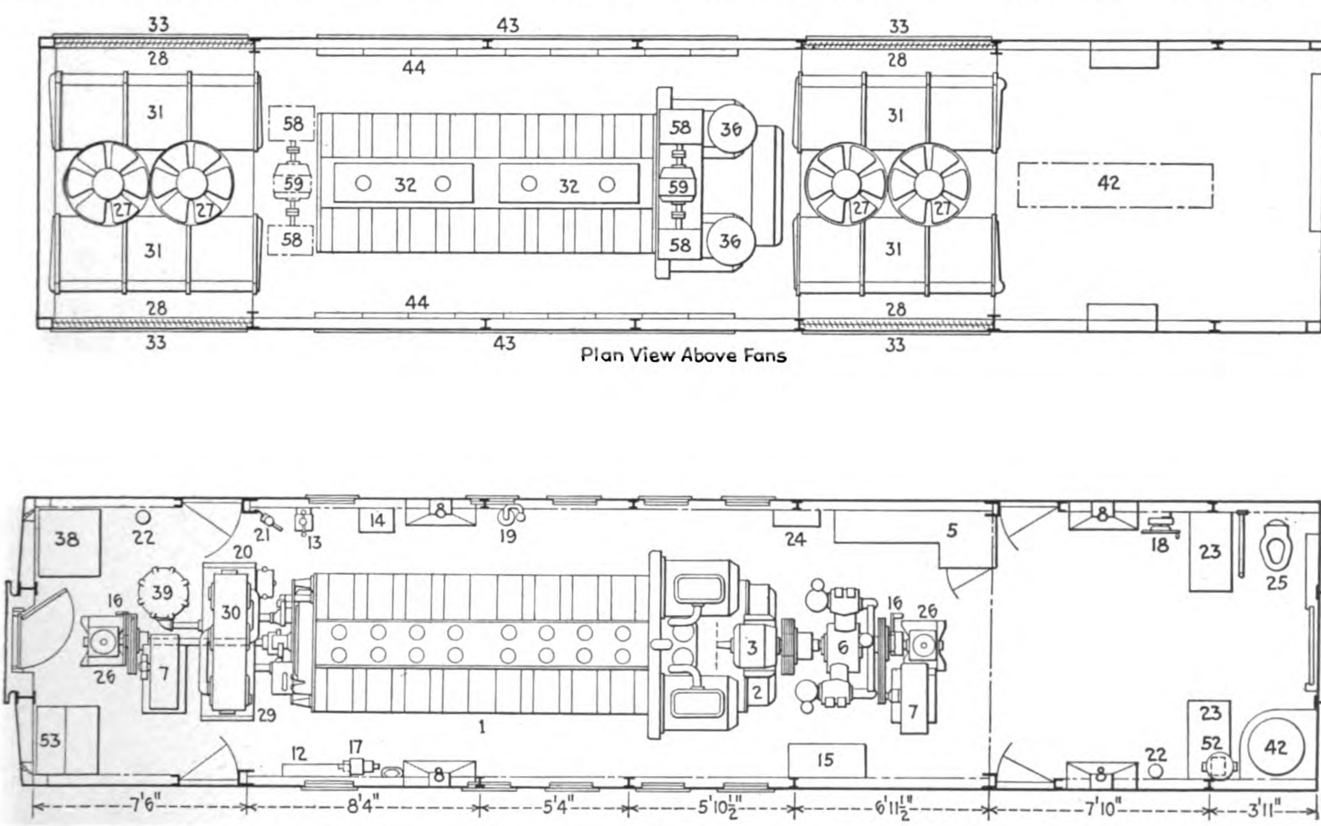
The four-wheel truck assemblies are interchangeable. Greater stability and improved riding qualities in negotiating curves are obtained by the same method of load suspension as on Electro-Motive six-wheel trucks for passenger locomotives. The alloy cast steel truck frames, made by the Locomotive Finished Materials Company, are supported on each of the four journal boxes by twin-group coil springs. The swing bolster is supported at each end by quadruple full-elliptic springs. These springs rest on each end of the spring plank which in turn is carried by spring hangers pivoted from the outside of the truck frame. Each of the two traction motors in each truck is supported by the driving axle to which it is geared and a spring motor nose suspension on the truck transom. Truck assemblies are equipped with EMC design clasp brakes actuated by four brake cylinders per truck.

Four hydraulic shock absorbers are mounted between the truck frame and bolster to eliminate excessive lateral oscillation and to ease the body against the truck frames when entering or leaving curves.

The 6½-in. journals are equipped with Hyatt roller bearings of special EMC design, whereby the lateral thrust is removed from the journal bearing itself and taken through a cushioning arrangement directly on the

Principal Dimensions of Santa Fe 5,400-Hp. Diesel Locomotive

Overall length, ft.	193
Width over body posts, ft.-in.	9-10
Height above rail, ft.-in.	14-1½
Distance between truck centers, ft.-in.	27-3
Truck wheel base, ft.	9
Number of pairs of driving wheels	16
Wheel diameter, in.	40
Sand capacity, cu. ft.	80
Fuel capacity, gal.	4,800
Weight on drivers (fully loaded), lb.	923,600
Starting tractive force	220,000
Factor of adhesion	4.2



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37—Fuel Filler
38—Batteries
39—Lub. Oil Filter
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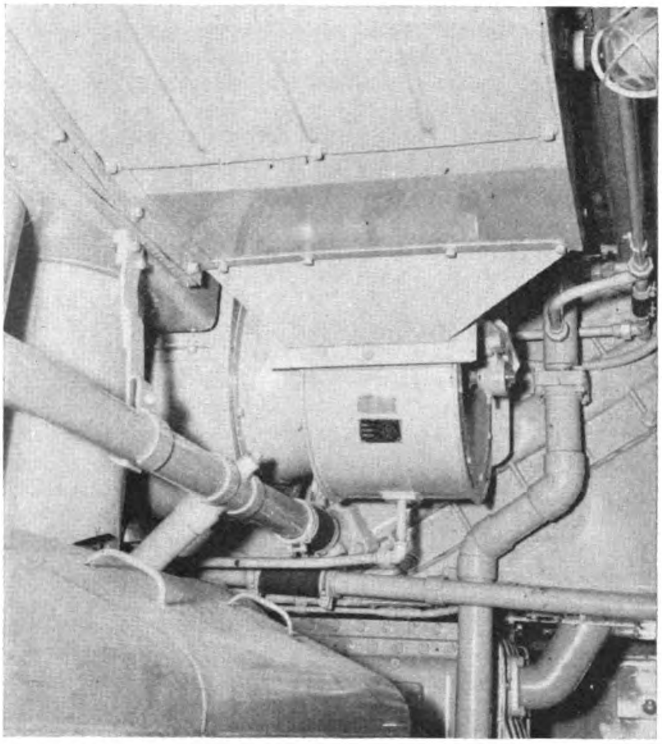
41—Generator Service Door
42—Main Air Reservoir
43—Air Intake—Engine Room
44—Air Filters
45—Fuel Tank Gauge
46—Door
47—Classification Light
48—Classification Flag Bracket
49—Blue Flag Bracket
50—Locker
51—Seat
52—Air-Brake Equipment
53—Distribution Cabinet
54—Instrument Panel
55—Louvers
56—Grids
57—Air Duct
58—Blower
59—Motor
60—Flag and Signal Lamp Bracket
61—Speedometer
62—Shift Indicator
63—Dynamic Brake Control

Floor plan and plan view above the fans of the No. 2 section of the Santa Fe Diesel-electric freight locomotive



Motor-driven blower for cooling the grids in the dynamic brake circuit

box. Journal-box pedestal guides are equipped with spring-steel wear plates.

The truck center plate is designed with wear plates, dust guard and lubricating arrangement. Although the truck center plate is so large that there is no need for side bearings, the usual friction-type side bearings are included; also a special EMC-design truck and body interlock which serves to prevent the truck from sluing in case of derailment.

The Brakes

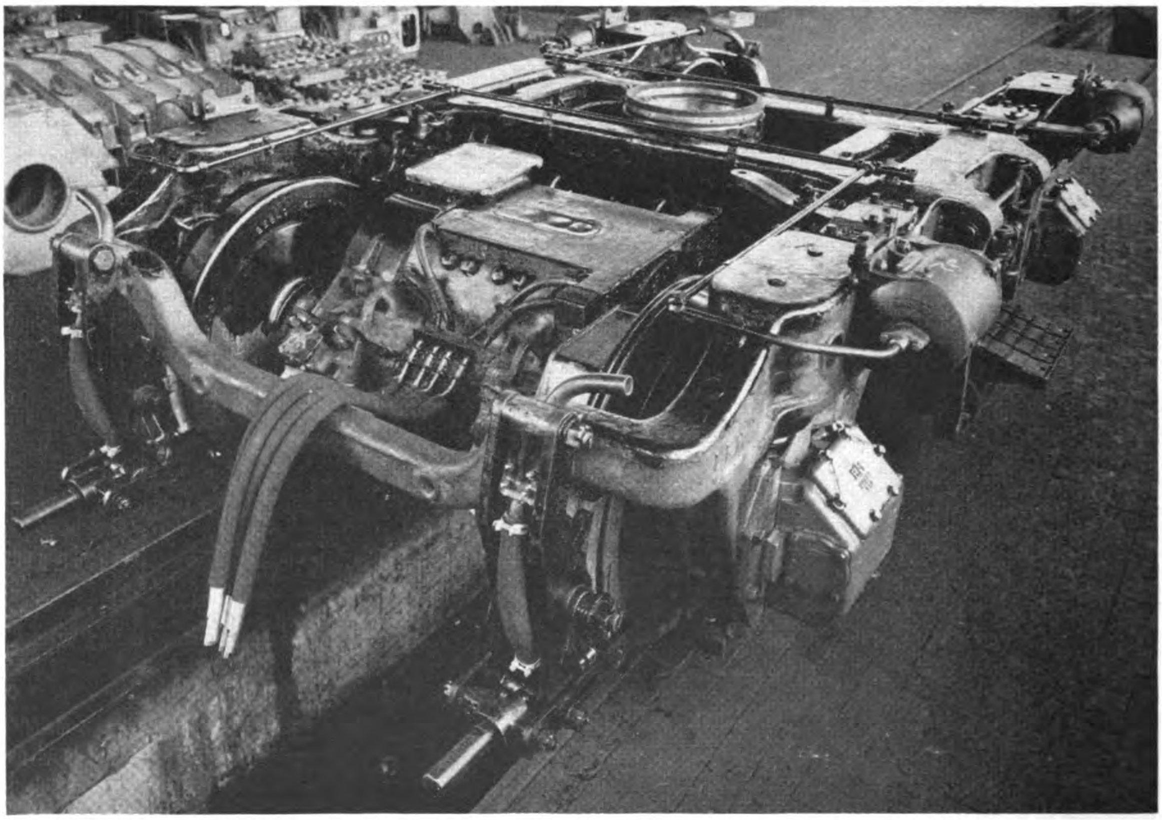
Westinghouse No. 8 EL brake equipment is installed, with KS-8-PB brake valve, safety control features and maximum-speed governor control. The brake pipe consists of copper tubing with extra-heavy brass fittings. Main reservoirs, only, are made of USS Cor-Ten steel with riveted seam and welded heads and have a capacity of 25,000 cu. in. each.

The brake-lever ratio on the truck is 5.66 to 1. Two 18-in. brake shoes per wheel give an average shoe pressure of 12,250 lb. in an emergency application. Based on an average loaded weight of 836,000 lb. for the locomotive, the braking ratio is 70 per cent with 50 lb. brake cylinder pressure, or 95 per cent with 68 lb. cylinder pressure.

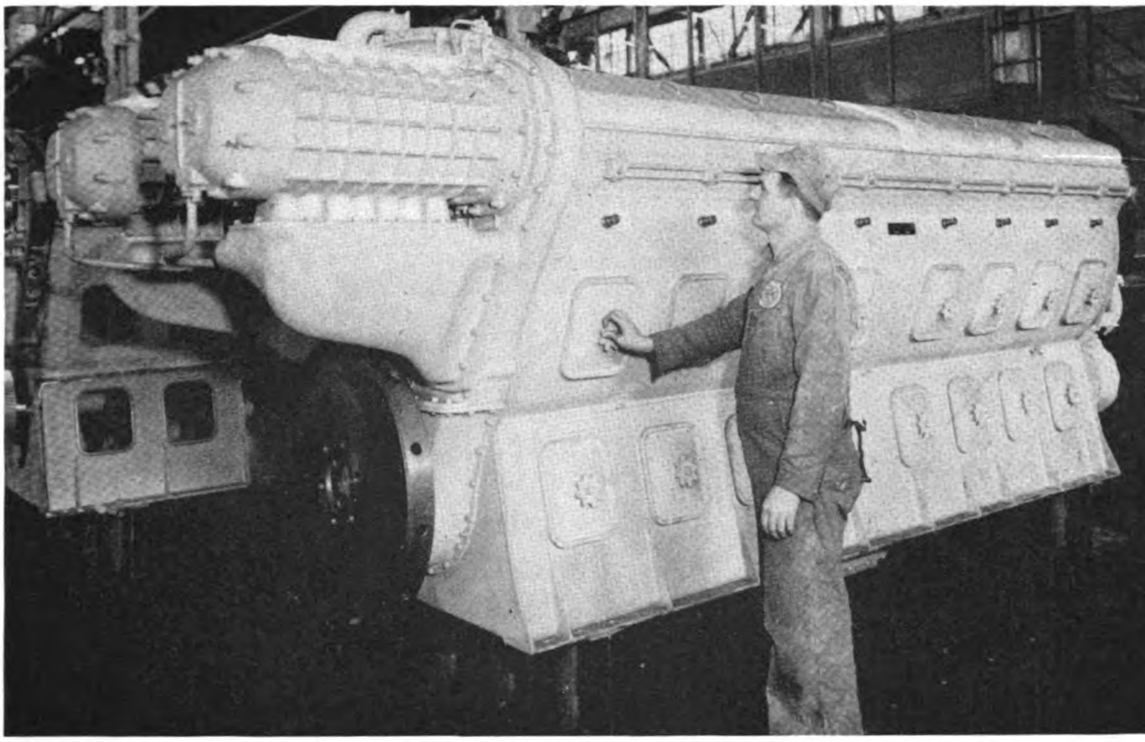
During operation of the electric retarding brake, the power generated by reversed traction motors is fed back into air-cooled stainless-steel grids located in the roof where heat will be easily carried off. The brakes are designed to exert a retarding force of 80,000 lb. at 22 m. p. h., with a lesser step at which the retarding force is 54,000 lb. at 33 m. p. h. At the higher step the grids dissipate 4,690 hp. and at the lesser step, 4,753 hp. In either case the traction motors generate 540 amp. The brakes are designed to retard safely downgrade any load that the locomotive can haul up the same grade.

Power Plant Equipment

Motive power is derived from four 1,350-hp., 2-cycle, 16-cylinder General Motors Diesel engines, one in each locomotive section. Each engine is direct connected to an EMC 600-volt d. c. generator and a two-stage, three-cylinder Gardner-Denver air compressor. A supplemental 10-kw. auxiliary generator, adjustable between 74 and 78 volts, is mounted above and driven by vee



One of the four-wheel power trucks ready for application under the locomotive



General Motors 1,350-hp., 16-cylinder, 2-cycle Diesel engine—Seen from the blower end

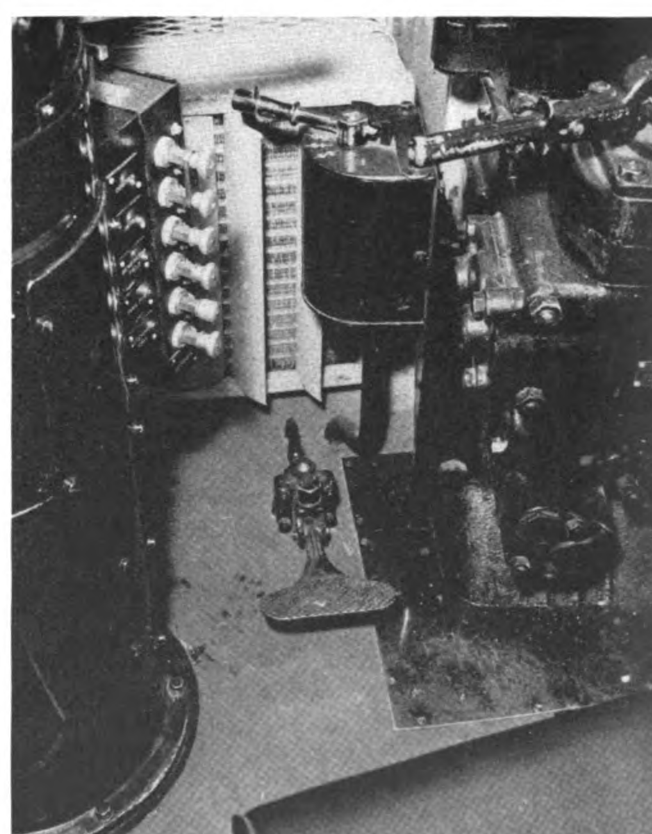
belts from each main generator. The generators are used as motors for engine starting. Each generator feeds four EMC Type D-7b d. c. roller-bearing motors, two in each truck assembly, directly geared to the driving axles. Motors are cooled by clean air delivered from blowers in the body immediately above the motors through ducts in the floor which connect with flexible rubber ducts held against the motor-housing air intake ports.

High-voltage control consists of manual transition forward and backward, with four motor connections, series-parallel, series-parallel-shunt, parallel and parallel-shunt. Switch equipment for transmission of single generator output to four traction motors is suitably arranged in ventilated cabinets. All high-voltage circuits are safeguarded by a ground protective relay. Two Exide 32-cell storage batteries are located, one in each first section.

The cooling system for the engines consists of two 200-gal. per min. engine-driven water pumps and forced air circulation through Harrison fin-tube radiators located in the ceiling of the engine rooms. Each engine has a separate water supply tank with cooling-system capacity of 225 gal. Provision is made for steam jet preheating of cooling water from an external source after a layover period, if desired. Engine temperature control is accomplished by forced air circulation through seamless-tube type radiator assemblies. Four vertical 34-in. fans, driven from the engines through clutches, deliver approximately 80,000 cu. ft. per min. of air per engine. The engine air delivery is completely controlled by means of the fan clutches and by the manually operated shutters mounted in the air intake ducts, located along the top of the locomotive sides.

A dual circulating lubricating-oil system is installed for each engine. This comprises a single-pressure pump for oil delivery from the supply tank to the engine lubricating system, a separate pressure pump for oil delivery from the supply tank to the piston cooling system and a scavenger pump for oil delivery from the engine sump through a four-element filter and three Harrison oil coolers into the supply tank. The capacity for the system is 190 gal. A motor-driven dual pump per engine drives the return-flow fuel system. The fuel tank capacity is 1,200 gal. per section, or 4,800 gal. total.

The electro-pneumatic trunk-line control system com-



Dynamic brake control and dead-man pedal on the cab floor

Diesel engine and motor controls—Traction-motor transition indicator

prises: (a) An engineman's control station containing throttle with engine-speed control mechanism, motor connection lever, reversing lever with actuating means for control of traction motor reversing position which lever when removed from the station voids all locomotive movements; (b) four-valve, eight-position, electro-pneumatic engine-governor operating mechanism, mounted on the engine; (c) power-plant control push-button box with fused switches for master control circuit, generator field, fuel pump and push button for engineman's helper call signal and defroster blower switch; (d) locomotive light switch box with five push button controls; (e) instrument panel, indirectly lighted, containing air-brake gages, speedometer and wheel-slip indicator; and (f) main-generator load meter to indicate proper motor connection.

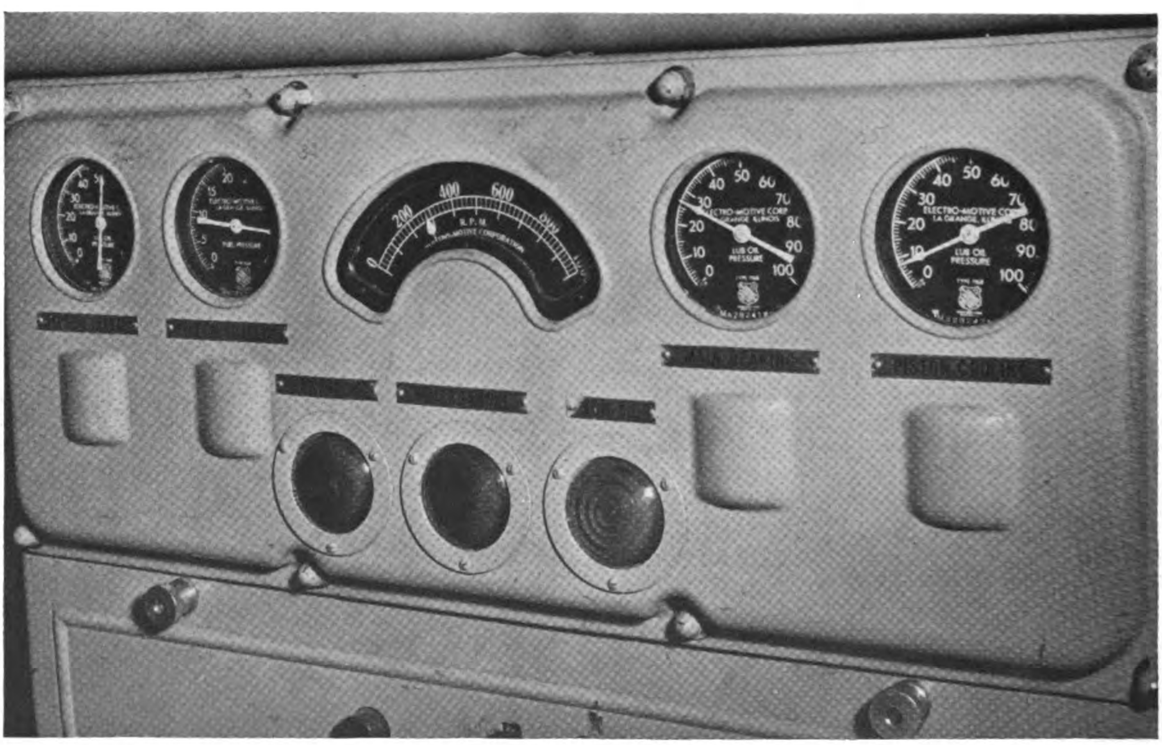
A local control station is installed in each engine room and includes start and stop buttons, isolation switch, master air valve to electro-pneumatic governor control, alarm system to show low oil condition, tachometer, lubricating-oil and fuel pressure gages, hot-engine indicator and fuel-pump contactor. The signal alarm system shows by gongs and colored lights low lubricating-oil pressure, hot engine water, wheel slip and hot journal.

Warning signals include soft and loud air-operated horns and one EMC 12-in. locomotive bell with internal ringer. Hot water, led from the engine-cooling system into two units with a fan-driven air circulating system is used to heat the cab control stations.

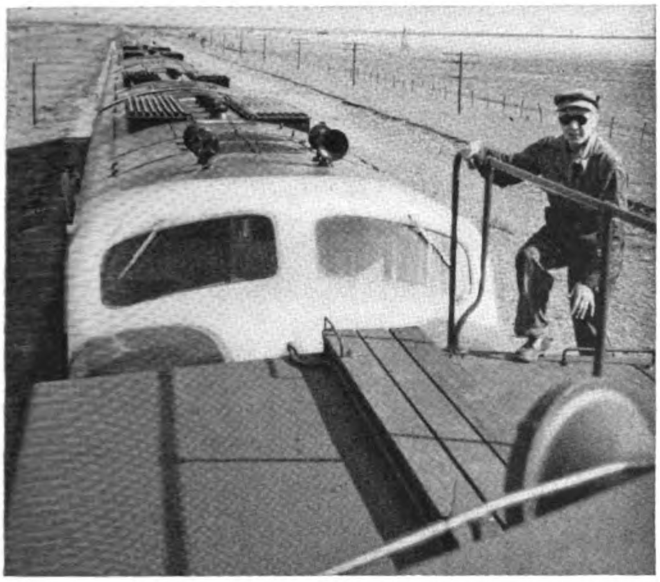
The Duco color scheme of the locomotive is Santa Fe dark blue with a wide yellow band separated from the blue by narrow vermilion stripes. A bronze Santa Fe medallion adorns each front end.

The Test Run

In addition to a varying number of freight cars, the west-bound test train included, at the head end, Diesel locomotive No. 100, a dynamometer car and five business cars to accommodate officers of the railroad and the locomotive builder, as well as about 20 observers who were invited to witness the tests. The train left Argentine, February 5 and arrived at Los Angeles February 8, in a total elapsed time of slightly over 72½ hr., as shown in the table which gives the general test results. No particular attempt was made for a speed record either by means



Pressure gages for fuel and lubricating oil, engine-speed indicator, and hot-engine, boiler-failure and low-water alarms



Top view of the Diesel freight locomotive taken during the test run

of unusually high operating speeds or reduced delays on the road and at terminals. As a matter of fact, the running time for this trip of 1,761.8 miles was 54 hr. 35½ min., which gives an average running speed of 32.3 m. p. h.

The locomotive demonstrated ample reserve capacity to handle heavier trains than the one used in the test and at substantially higher speeds. For example, the test train, with a maximum of 68 cars and 3,150 tons, was handled successfully over ascending grades up to 1.6 per cent westbound, without a helper, and at a speed generally of about 30 m. p. h. The maximum speed attained during the run was 68 m. p. h. between Amarillo, Tex., and Clovis, N. M., this portion of the road being predominantly a 0.6 per cent ascending grade.

On descending grades, the locomotive gave an excellent account of itself due to the dynamic brake. This feature was used at four places during the run for a total of 83 miles; namely, from Mountainair, N. M., to Belen, 17.5 miles; Supai, Ariz., to Ash Fork, 20.0 miles; Louise, Ariz., to Yucca, 23.0 miles; and Summit, Cal., to San Bernardino, 22.5 miles. Maximum grades on these four mountains ranged from 1.27 to 3 per cent. At a speed of 20 m. p. h., the retarding effect exerted behind the locomotive was 48,000 lb., and the horsepower 2,560. At 29 m. p. h., the corresponding figures were 35,200 lb., and the horsepower 2,730.

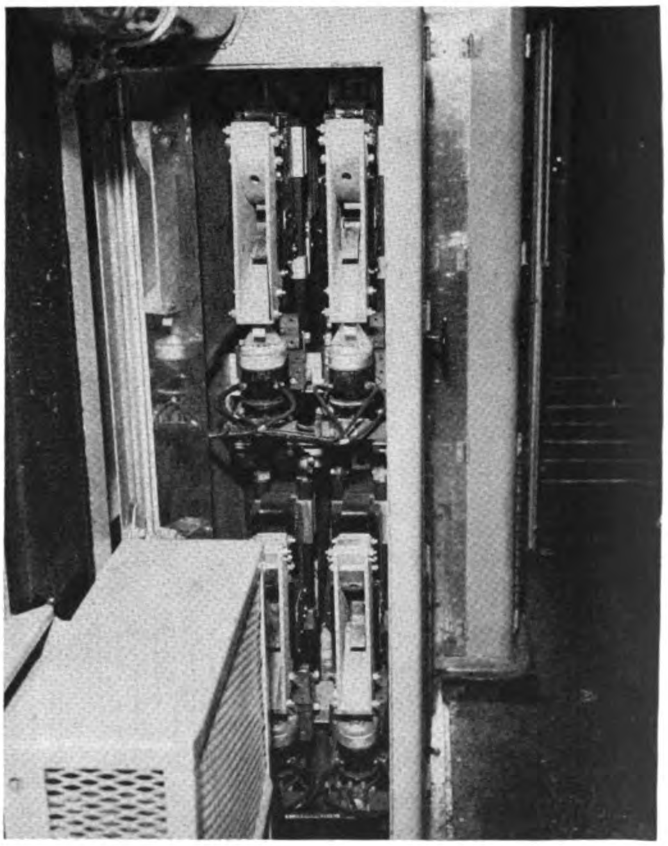
In negotiating the 3 per cent descending grade westward from Summit, the train length was limited to 50 cars in accordance with customary Santa Fe practice and the retaining valves were set up as an added safety measure. Where the dynamic retarding brake was used, it was necessary to set the train air brake only about one-fourth as much as usual. There was no evidence of excessive wheel heating throughout the run and when stops were made after descending heavy grades, the wheels never much exceeded bare hand temperature. The total energy absorbed by the dynamic brake during its use on this run is estimated at 19,700 million foot pounds, or approximately 10 per cent of the entire energy that was used to move the train throughout the test run.

The next most significant thing about this Diesel freight locomotive test run was the fact that a total of seven steam locomotives would ordinarily have been required to take the same train from Argentine to Los Angeles, with not less than 28 stops for water, on 12 of which fuel would also have been taken. The Diesel locomotive made the entire trip with only four stops for fuel and the addition of a little engine cooling water; namely, at Wellington, Kan., Clovis, N. M., Winslow, Ariz., and San Bernardino, Cal. The locomotive was serviced at Los Angeles and could have started the return trip, if necessary, with practically no delay.

Santa Fe 5,400-Hp. Diesel Freight Locomotive Performance on First Revenue Run from Argentine, Kan. to Los Angeles, Cal.

Total distance, miles	1,761.8
Running time, hrs.	54.59
Dead time on road, hrs.	6.15
Total time on road, hrs.	60.74
Dead time at terminals, hrs.	11.83
Total elapsed time, hrs.	72.57
Total number of stops	54
Minimum number of cars	49
Maximum number of cars	68
Minimum number of tons	2,262
Maximum number of tons	3,150
Thousands of gross ton-miles	5,171
Average running speed, m.p.h.	32.3
Average speed, total time on road, m.p.h.	29.0
Average speed, total elapsed time, m.p.h.	24.3
Minimum speed on grade, m.p.h.	15.0
Maximum speed on run, m.p.h.	68.0
Million ft. lb. at drawbar	198,858
Total fuel oil consumption, gal.	10,830
Unit fuel consumption, gallons:	
Per mile	6.15
Per thousand gross ton-miles	2.09
Per million ft. lb.	0.0542

Tonnage trains may be handled by this Diesel locomotive with fuel stops spaced 500 miles apart. The distance between the Santa Fe refueling stations, mentioned above, averaged 440 miles. Due to the installation of adequate fuel-pumping facilities and individual hose lines to the locomotive sections, the actual refueling time on the test run was shown to be 7 min., which



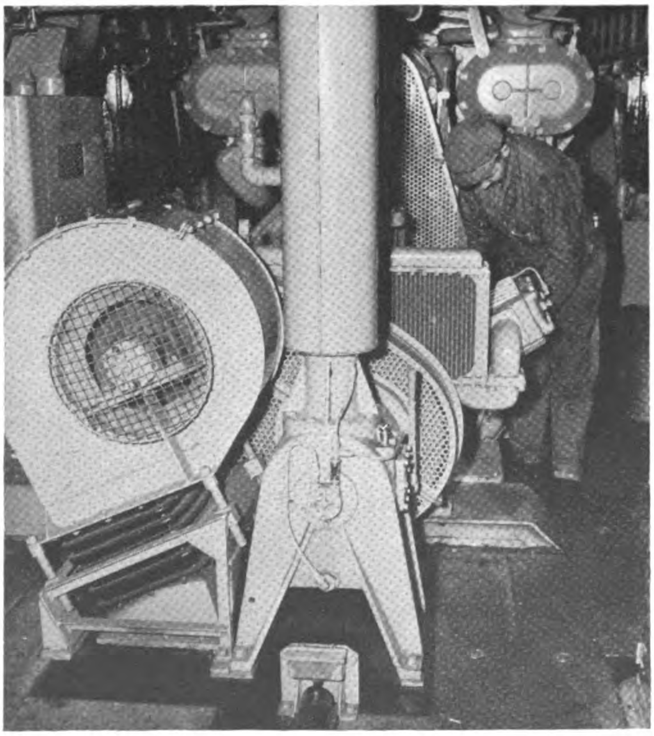
Dynamic brake contactors—Upper contactors for power, lower contactors for braking

The first 5,400-hp. Diesel-electric freight locomotive for the Santa Fe—Built by the Electro-Motive Corporation

may be compared with 35 min. formerly required when refueling from tank cars. On this particular run the locomotive consumed an average of 6.15 gal. of fuel per mile. In hauling the test train 1,761.8 miles, the unit fuel consumption of the locomotive was 2.09 gal. per 1,000 gross ton-miles and 0.0542 gal. per million ft. lb. of work done at the drawbar.

During the test run, and subsequently, this Diesel locomotive showed notable reliability of performance and high availability for service. After being thoroughly broken in, the locomotive made the test run without any special mechanical attention except the replacement of one cracked cylinder liner and cleaning two oil filters.

In both starting and rate of acceleration, the locomotive demonstrated highly desirable characteristics. With full engine power available from rest, the locomotive easily started tonnage trains and accelerated them to desired operating speeds in much less time than formerly required. Apparently the only necessary precaution, as indicated by the test run, is to increase the power output of the Diesel engines and the corresponding drawbar pull slowly enough so that unnecessary shocks and excessive stresses will not be introduced into the freight-car couplers and draft connections. There is no wheel slippage with this locomotive except possibly under unusually adverse wheel and rail conditions.



One of the electric-motor cooling fans installed in the engine room

C. & I. M. Rebuilt Caboose

(Continued from page 132)

side is used mainly for the storing of mattresses, bed clothes, etc., and the other side for the storage of oils, dope buckets and other train supplies. Kick plates, chromium plated, approximately 18 in. wide, are applied on each side underneath steps leading from the floor of car to the cupola platform and grab irons of 1-in. pipe are applied from the cupola roof to the cupola platform.

A flush-type stationary cabinet is also built into this space under the cupola for carrying the conductor's reports, stationery, etc. This is easily accessible to the conductor from his position in the section utilized for making out reports, etc.

Car light is supplied by the use of a lamp over each one of the lower berth sections, as well as a lamp over the work table used while the train crew is cooking and preparing meals. These lamps are of the improved coal-oil type with reflector. The 40-gal. water tank above the kitchen work table and sink is fully enclosed by fir plywood and supplies water for cooking, as well as for cooling hot boxes.

All doors on the car are finished by applying plywood over the standard door panels. The batten strips on the ceiling and walls, as well as all hardware in the car, are chromium plated. The car is equipped with a thermometer, drinking-cup container and fusee racks on both ends of car. All seat cushions and backs were covered with a No. 8 canvas duck in wide white and orange striping.

The entire interior of the car has a natural finish, the plywood being given two coats of white shellac and two coats of white varnish. The exterior of the car is finished with one coat of primer and two coats of caboose red Dulux enamel. C. & I. M. standard letters, numbers and monograms are applied. The car as rebuilt weighs 46,000 lb.

EDITORIALS

Little Corrosion In Passenger Cars

One of the important considerations in deciding whether to scrap or rebuild and convert railway car equipment is the amount of corrosion and deterioration which have taken place at critical points in the steel structures. In the case of steel passenger cars, at least, all evidence points to the fact that excessive weight and obsolescence limit the economic service life of the equipment far more than corrosion reduces its period of safe and effective service. One car owner, for example, reports that an examination of passenger-car structures 30 years old, which were thoroughly inspected during remodeling when the framing was exposed, showed an excellent condition of the steel frames and indicated strongly that corrosion is not a real factor in the life of passenger cars. Since the modern high-tensile steels now extensively used in passenger-car construction are reported to have at least four to six times the corrosion resistance of the steel used in older cars, the possibility of corrosion difficulties are still further reduced. It may be safely assumed, therefore, that passenger cars of the future will be written off and scrapped, as they have been in the past, primarily because their designs are obsolete and not on account of weakened structures due to corrosion.

Use Your Head

Unfortunately we humans, as a general rule, learn only from bitter experience. How frequently do we hear people say, "If we had only known, we would have acted differently." And yet, probably in most instances they had been warned, but went ahead regardless. One of the former Lehigh Valley apprentices, now working to qualify as a first-class machinist at the Charleston, S. C., Navy Yard, recently sent a letter to the supervisor of apprentices on that road at Sayre, Pa. "I am writing this letter," he said, "to plainly tell you that you were right and I was wrong when I was serving my apprenticeship. I want to tell you and Mr. Laux [J. P., the S. M. P.] and everyone else connected with the apprentices, that I wish I had been more careful with my lessons and listened to you all." In telling of his efforts to qualify for a better status he said that, "There isn't a job here a machinist gets that a blueprint isn't with it." In another part of his letter he said, "Although I am not trying to tell you your job, show this letter to some of your delinquent boys (if you have any) and tell them to snap out of it and profit by my mistakes."

Apprentice boys, however, are not the only ones who fail to profit from the experience of others and who find themselves regretting it later on. It is an error that most of us are likely to make, because we will not make the effort to face up to the realities and think our problems through to a logical conclusion. Rather, we are too inclined to stumble along indifferently, or in the attitude that somehow or other things will all work out satisfactorily in the end.

Significant Motive-Power Developments

Two articles in this issue deal with notable developments in the field of motive power. One is the description of the 5,400-hp. Diesel-electric freight locomotive recently placed in service on the Atchison, Topeka & Santa Fe. The other is the account of the road tests of the Pennsylvania Railroad's Pacific type locomotive equipped with the Franklin system of steam distribution with O. C. poppet valves.

The Diesel-electric locomotive is essentially a constant horsepower machine and its tractive-force curve approaches a hyperbola. If the voltage-current relationship were free from limitations, the tractive force of such a locomotive would, theoretically, approach infinity as the speed dropped toward zero. Practically, the maximum traction is limited by the weight on drivers and in the Santa Fe locomotive is rated at 200,000 lb. Such a locomotive possesses tremendous train-starting capacity and high accelerating capacity in the lower speed range—the range which is of relatively greater importance in freight-train operation than in passenger-train operation. Adding the dynamic brake, which is installed on the Santa Fe locomotive, this locomotive is particularly well adapted for heavy freight movements on lines with heavy grades—in the down-hill as well as the uphill direction.

The poppet-valve installation is on a steam passenger locomotive and the road tests were in heavy, fast passenger service. Marked increases in capacity were shown at speeds above 50 miles an hour as compared

with a standard locomotive of the same class tested under similar road conditions. These increases amount to nearly one quarter at 60 miles an hour, almost one third at 70 miles an hour, and more than two fifths at 80 miles an hour. The results of these tests indicate that the poppet valve, through its more effective control of the admission and release of steam from the cylinders, provides a material extension in the limitations on the steam locomotive as to speed and capacity in passenger-train service. It will also undoubtedly influence the design of the steam locomotive built for heavy, high-speed freight service, the operating range of which will not fall far below that of the passenger locomotive, at least when measured in terms of revolutions per minute of the driving wheels.

Thirty years ago electrification appeared to be a serious contender for first place as the source of motive power for the railroads. Today, the Diesel-electric locomotive appears to be a more serious contender. It has many operating advantages but has yet to attain a clear title in the realm of economics. The outstanding advantage of the steam locomotive is its low unit first cost. Its future depends upon the continuance of the development of such improvements as that here referred to, without greatly increasing its unit first cost.

Defective Trucks Cause Many Hot Boxes

In an authoritative and highly constructive report, presented at the 1940 annual meeting of the Car Department Officers' Association, attention was called to a three-month survey of train detentions due to defective freight-car equipment on six representative roads, which showed that 1,183 train delays, or 52.4 per cent of a total of 2,255 delays, were caused by hot boxes. Judging from the figures quoted it seems reasonable to believe that concentrated efforts to improve this one undesirable feature of train operation will be more productive in reducing train delays than attention to any other single defect.

While proper lubricating materials and their application are obviously of the utmost importance in any campaign to minimize hot boxes, the committee report contained the following significant statement: "It is the consensus of your committee that improper truck maintenance is probably responsible for as many hot boxes as is the improper packing of boxes." Attention is thus directed to a sore spot in freight-car maintenance at many car repair points, and the committee suggests a remedy in attention to a number of details in maintaining freight-car trucks, the importance of which can hardly be over-emphasized.

Defective wheel conditions which may cause waste grabs and hot boxes come in for first consideration. Wheel-shop practice needs constant checking to make sure that journals are turned and rolled accurately and with the desired smoothness of finish. Obviously, this finish needs to be protected during the entire subsequent handling of the wheels until safely placed in the truck with brasses applied to protect the journals. Unless substantially more care is exercised than is sometimes the case in handling wheels, truck sides and bolsters in making truck assemblies, it is difficult to prevent journal collars and back fillets from becoming nicked, or the journals marred. Even a slight damage to the journal collar or back fillet is almost sure to cause a waste grab and hot box.

Similar careful attention to applying brasses which are in good condition, fit the journals and have also been protected against damage in handling, is also important. Wedges with straight backs are a definite invitation to bearing troubles and, if the wedge back condition is important, the bearing surface in the top of the side frame is equally so. A good many hot boxes are charged to the pinching of journal bearings on account of concentrated loads on the edges of the journal-bearing wedges, this condition being caused by hollow box roofs. Sometimes, on new boxes, there is a small fillet at the junction of the roof with the side wall instead of an undercut which is necessary to provide a smooth and straight bearing surface for the wedge.

Individual cases of carelessness and poor judgment probably mean little in their effect on the railroad problem as a whole, but when, as recently happened, qualified carmen and their foremen permit a freight-car truck to leave the shop with a non-standard replacement truck side which holds the plank 1½ in. higher above the rail than the other side frame, it is natural to wonder how often this may have happened. Conditions have been observed, where the spring plank itself was too short between the centers of the truck frames, causing them to bow in and resulting in a heavy pressure on the journal fillet. Similarly if the spring plank is too long and forces the truck frames to bow out, excessive fillet pressures and potential hot boxes are in prospect.

Proper attention to truck springs is essential and while broken springs are probably almost always replaced, more careful checking should be made to replace springs with less than the desired free height, which, if permitted to remain in service, present the probability that the journal will be subjected to over-solid blows and the brass distorted. To the extent that spring snubbers decrease the frequency of, or eliminate, over-solid blows, they also tend to prevent hot boxes. Still another mechanical condition, over which carmen have little control, but one undoubtedly chargeable with many hot boxes, is improper load distribution in cars, with resultant excessive loads on individual bearings and inevitable tendency to over-heat. Concentrated attention to even this limited list of truck defects will be sure to effect a further decided reduction in hot boxes.

Tool Engineering Assumes Important Role

The 1941 annual meeting and exhibition held by the American Society of Tool Engineers at Detroit, Mich., March 25 to 28, was something more than a big show and an important series of meetings; it was the tangible evidence of what can be done by a wide-awake organization with a purpose in building the society from a small group of 50 members in 1932 to almost 7,000 members in 1941; it was also a fine demonstration of the implements of production that have made America a great industrial nation. The exhibition and the technical sessions carried the work of production for national defense as a basic theme and showed how output is being and can be stepped up in work of such vital importance by the application of modern tools and tooling equipment.

Among the more than 250 companies which exhibited were many whose products are used by and are familiar to the railroad industry and it was noteworthy that the work of the society, its annual meeting and exhibition is attracting growing attention on the part of railroad men.

Tool engineering as a mechanical science and the work of the tool engineer has always been more or less associated with mass production such as that of the automotive industry. It is true that in such industries where there is a large volume of repetitive operations the possibilities for tool engineering are great. Hence, many men in railroad shops have ignored the real opportunities that are right at hand for improving the methods used in the machining and fabricating of locomotive and car parts because they have assumed that the relatively small volume of work of a given type or design must, of necessity, be done by the same methods that have prevailed for years. Such, however, is most certainly not the case, as many examples to be found in railroad shops today will prove.

Recently we were discussing the possibilities of better tooling methods with a mechanical officer who came up through the shop and is in intimate touch with shop work. He recalled a study that had been made in one of the shops on that road with the object of cutting down the cost and increasing production on a group of parts used in quantity on locomotives, which required operations on four types of machines in the shop. The tooling arrangements were carefully analyzed with the idea of stepping up the output of each of the four machines. Before any action was taken a visit was made to several industrial plants to see how similar work was done on a large-volume basis and as a result of these inspection trips it was found that the purchase of a single new machine with rather simple tooling equipment not only would make possible such an increase in output that the one shop could take care of the requirements for the entire road but the reduction in cost per part produced was sufficient to pay for the new machine in a surprisingly short period of time. The important thing was that the new machine was able to utilize tooling equipment and tool steels that it was impossible to use on any one of the four older machines that had previously been doing the work.

One need only spend a little time in the average railroad shop to realize that there are hundreds of ideas in every-day use in other industries that could be adapted to the operations performed in a railroad shop and save many thousands of dollars in the cost of locomotive or car maintenance.

Many of these ideas are not adopted because the average railroad mechanical officer thinks that a tool engineer, tool supervisor, shop engineer or a production engineer is just so much excess baggage on the payroll. Then, too, many roads have extremely capable men charged with the responsibility of improving methods in shop operation that are kept tied so close to their own roads and their own industry that they really do not have a chance to know what is going on in the world of industrial production.

No railroad shop man in a responsible production supervisory position could attend meetings and make contact with the production men from other industries such as were at Detroit for the A. S. T. E. 1941 Exhibition without bringing home enough new and usable ideas to pay for his time and expenses many times over.

New Books

PROCEEDINGS MASTER BOILER MAKERS' ASSOCIATION. —The price of the Proceedings of the 1940 Annual Meeting of the Master Boiler Makers' Association is $5 and not $3 as stated in the New Books column on page 108 of the March issue of the *Railway Mechanical Engineer*.

WELDING METALLURGY. *Volume I-II, 1940. By O. H. Henry, associate professor of metallurgical engineering, and G. E. Claussen, research assistant, Welding Research Committee, and adjunct professor of metallurgy, Polytechnic Institute of Brooklyn. Published by the American Welding Society, 33 West Thirty-ninth street, New York. 357 pages, illustrated. Bound in imitation black leather. Price, $1.50.*

Welding Metallurgy deals with the structure, properties and composition of the welded materials from which may be deduced the cycle of events which brought them about, or vice versa. It is a series of lectures prepared for presentation in a fundamental course of metallurgy and metallography at Polytechnic Institute of Brooklyn under the joint auspices of the Institute and the New York Section of the American Welding Society. It is intended to familiarize members of the welding industries, including fabricators and designers, with the composition and structure of the steel they use; to show how the steel is affected by the varied conditions of heat and stress in welding; to explain the mysteries of heat treatment, and to point out the way in which metallurgy can be used to control the welding process. The two volumes are bound together in one book.

Suggestions for Mechanical Associations

National Defense and Association Activities

The membership of the mechanical associations can only be built up if the railroad managements show that they are interested by allowing men to attend the meetings. In the past few years this has been impossible, due to the depression, but it would appear now that the necessity for improvements brought about by the defense program will stimulate the desire of the managements to obtain quicker methods of repairs, and lasting improvements. The work of these associations is very beneficial to both the members and the railways.

Freight Car Defects And Damage to Lading

I think the Car Department Officers should have a committee to deal with structural defects in equipment, as observed in service, in order that their findings could be placed before the Car Construction Committee, much as the territorial car foremen's associations now do with respect to interchange rules. I do not refer to design as such, but to the serviceability of the car as a protective freight vehicle. The Freight Claim Division, A. A. R., presented a long list of such defects to the Mechanical Division in 1937. This list by no means exhausts the so-called defects that reduce the opportunity to deliver the service we owe to the public. It ought not to be left to the claim men to make these discoveries available to those who can correct them or to stop them being produced in the first instance. The car man sees these deficiencies long before a claim voucher brings them to light. Ordinarily, freight damage producing defects in car structure do not come before the Mechanical Division's Committee on Car Construction from any organized source. The best such source would be the Car Department Officers' Association.

Hustle Committee Reports

I hope you will emphasize the necessity of getting the committee reports completed as quickly as possible. In order to get them out to the members of the associations early enough so that they can be read and digested before the meetings, they must be in the hands of the officers of the associations within the next few weeks and surely not later than June 15; the procedure of one of the associations—the Car Department Officers — requires a much earlier closure. I realize that mechanical department officers and supervisors are unusually busy at the present time, and yet, these mechanical meetings can mean so much to the railroads in increased efficiency and economy that no stone should be left unturned to make their programs as complete and effective as possible. With only two-day conventions, the meetings must be packed to the brim with meaty, constructive material. As little time as possible should be used for presenting the reports at the conventions; if possible, they should be presented by title only. All, or practically all of the short amount of time available should be used for the discussion of reports by men who have not only read them, but have studied them carefully and critically. The four associations that are scheduled to meet in Chicago next September have a real opportunity to make good in a big way, or just scrape by, or fail abjectly. The people now on trial are the committee chairmen and the committee members. Indifference, or lack of energy or initiative on their part at this time can be a "monkey wrench in the gears." Have they the guts to make good, or will they gum the works and place an insurmountable handicap in the way of success?

Preparation of Reports

It is my opinion that the best results are obtained in gathering material for convention topics by having the committee members first arrange a questionnaire to go to members of the association who are known through their activities to have the information desired; this first effort should be the responsibility of the chairman of the committee. When this has been accomplished, the chairman should instruct members of the committee to write personal letters to members who they know are familiar with the subject. A questionnaire has no real value unless it is followed up to show the individual that there is more interest in the topic than the preliminary questionnaire. It serves to arouse interest and to obtain more discussion on the floor of the convention. Replies when received by committee members should be forwarded to the chairman, who can either reject or ask for further information. While this will entail considerable correspondence, those who are interested will not object; it will bring out facts and will indicate a desire on the part of the association to render service to the railway managements.

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Comments from readers on suggestions made in our November, 1940, number for making more effective the efforts of the Mechanical Department Associations. *See also January number, page 25; February, page 70, and March, page 109.*

Get Your Young Men Interested

The rebuilding of mechanical department organizations after the depression has made it necessary to promote many men to supervisory positions, some of them comparatively young. I well recall that when I was at that stage of the game, many years ago, the boss sent me to one of the conventions. What an eye opener it proved to be. I did not know until long afterward that the "old man" had tipped off one of the officers, and to my amazement and distress, I had to get on my feet and express myself—but it was one of the best things that ever happened to me. What is everybody's business is nobody's business. Would it not be well for each association to appoint at once a live committee to get busy and get many of these newly promoted and younger men to attend the conventions? More than that, they could well see to it that they are encouraged to take part in the discussions. These men need friendship and acquaintanceship with older men. They need the information and inspiration they will receive from the meetings. On the other hand, we need their youth and virility to carry forward our work more vigorously.

Do Criticizing On Convention Floor

These conventions are held for the purpose of developing new ideas and concluding many open questions on previous suggestions that have been made and referred to committees for investigation and development. If all those interested could participate in the discussions on the floor and express their ideas at the convention, instead of criticizing action taken at the convention after it is over, I am sure it would bring about greater efficiency.

Prepare for the Discussion of Reports

Steps should be taken now, while the committees are still working on the preparation of their reports, to plan for the discussion on the floor of the conventions next September. Even though the reports are not yet completed, the committee members can talk with or write to their friends about what they are working on. Or they can assemble the names of men who are specially well equipped to discuss the report and plan to send them copies of it as soon as it is available. In brief, now is the time to do some real promotion work and to make plans for following it up. This will have some valuable by-products. It should assist in securing a larger attendance at the conventions and in increasing the membership of the associations.

THE READER'S PAGE

Standing Boiler Tests

To the Editor:

The ingenious, yet simple method of testing locomotive boilers developed by the engineers of the New York Central has been suggested as an inexpensive means of supplying the lack of basic data relating to the performance of large modern boilers to which C. A. Brandt directed attention in his paper presented at the 1939 annual meeting of the American Society of Mechanical Engineers.* It seems to be generally believed that the results recorded during these standing tests are comparable in every way with the boiler performance obtained during tests on the road or on a testing plant. One phase of the question, however, has so far remained entirely in the background.

The pressure of the steam passing through the exhaust nozzle in the New York Central standing tests is maintained at a constant level. Does such a condition ever exist in actual locomotive operation? Mr. Collins considers the performance of the locomotive boiler to be entirely independent of the engines. This would indicate, if only indirectly, his agreement with Dr. Goss' assertion that the draft-producing action of exhaust steam is independent of the intermittency of the exhaust.

There is extremely little available information dealing with the precise effect of the intermittent exhaust in locomotives upon the draft. It might be supposed that only negligible variations in draft occur at high speeds, especially with smokeboxes of comparatively large volume. That may or may not be true with the front end arrangements commonly used in America. But marked fluctuations in smokebox vacuum, far beyond expectations, were found during tests of modern 2-8-0 type locomotives in England, even when the exhaust beats were occurring at the rate of 18 per second.† This would correspond to a speed of 63½ miles per hour for a two-cylinder single-expansion locomotive with 79-in. wheels.

Just what effect would this fluctuating draft have on the efficiency of combustion? Those who believe that greater uniformity of draft improves the efficiency of combustion must conclude that Mr. Collins' tests are being conducted under ideal conditions, and will show higher efficiency than corresponding tests carried out on a testing plant or on the road. On the other hand, it has recently been stated as a result of long experience with two- and three-cylinder simple engines, that the slight lifting of the fire caused by the exhaust beats of a two-cylinder engine tends to promote better combustion than when a more even exhaust is used.‡ If one accepts this theory, then it follows logically that road or plant tests will give a better boiler performance than standing tests on the same boiler. The reader may take his choice. This is only one of the many problems of locomotive design which will continue to provide ground for argument, pending further research.

Finally, attention might be drawn to the high exhaust-steam pressures shown in Figs. 12, 13 and 14, on pages 99 and 100 of the *Railway Mechanical Engineer* for March, 1941. If, in order to make the boiler steam freely, the exhaust passages must be choked to produce an average back pressure up to 24 lb. per sq. in. during normal operation of the engines, the fluctuations in exhaust steam pressure caused by the intermittency of the exhaust beats may be largely damped out, resulting in a practically continuous blast through the exhaust nozzle. In such a case, it is quite conceivable that standing tests, plant tests and road tests will give the same results.

The high exhaust pressures shown in these figures demonstrate clearly that the efficiency of the American locomotive front-end can still be vastly improved. Why be content with a loss of from 700 to 1,000 hp. in order to create sufficient draft in the boiler of a high-speed locomotive working at full power? Certainly, no means of reducing the loss of power due to back pressure in the cylinders should be left untried. This problem is discussed at length in Lawford H. Fry's article on page 347 of the *Railway Mechanical Engineer* for September, 1939.

Wm. T. Hoecker.

* See the *Railway Mechanical Engineer* for February, 1940, page 47.
† Three Cylinder High Pressure Locomotive, by Herbert N. Gresley, Proceedings of the Institution of Mechanical Engineers, London, July 7, 1925, page 945.
‡ Locomotive Boiler Design, by E. S. Cox, Proceedings of the Institution of Locomotive Engineers, London, January 26, 1938.

Boiler Drop Plug Performance

To the Editor:

The 29th annual report of the director, Bureau of Locomotive Inspection, Interstate Commerce Commission, shows that during the fiscal year ended June 30, 1940, there were eight boiler explosions caused by low water on steam locomotives in the United States, an increase of two over the previous year. This report includes a "Summary of Boiler Explosions Resulting from Crownsheet Failures," and shows a complete record of boiler explosions for the past nine years.

In contrast to this, the Southern Pacific Company (Pacific Lines) has completed its ninth year without any accidents of this type, due to protection afforded by multiple applications of boiler drop plugs in firebox crownsheets.

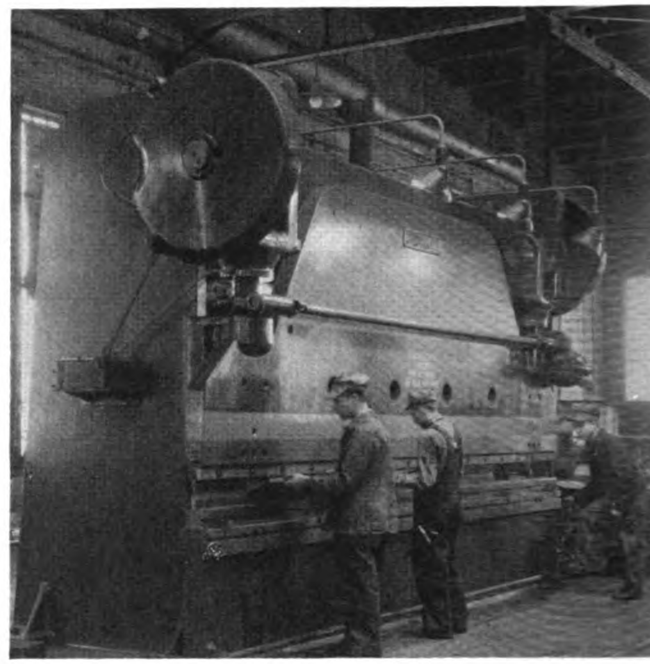
The performance of this safety device during the calendar year 1940, as summarized below, again conclusively demonstrates its absolute reliability and effectiveness as a safeguard to life and property against hazards of boiler explosions due to low water:

Locomotives equipped with drop plugs	1,383
Total number of drop plugs in use	5,402
Cases of low water—engine crew responsible	6
Cases of low water—enginehouse forces responsible	9
Total number cases of low water in which drop plugs functioned	15
Total number cases low water in which drop plugs failed to function	0
Total number of drop plugs which functioned	43

It will be noted that in 1940, as in all previous years that boiler drop plugs have been in use, they have functioned in time to prevent serious damage to the boiler or firebox. Of the 15 cases of low water that occurred during 1940, in 13, or 86.7 per cent, the only work necessary was the renewal of the boiler drop plugs. An analysis of the work required on drop-plug-protected locomotive boilers shows that in 107 of the 138 cases of low water since 1932, representing 77.5 per cent, the only repair work necessary was the renewal of the plugs.

F. E. Russell,
Mechanical Engineer,
Southern Pacific.

Bending Brake Fabricates Car Details at Omaha Shops



Bending a 6-ft. length of light-gage stock

A wide range of sheet-metal bending work is performed at the Union Pacific car shops, Omaha, Neb., on a Cincinnati bending brake.

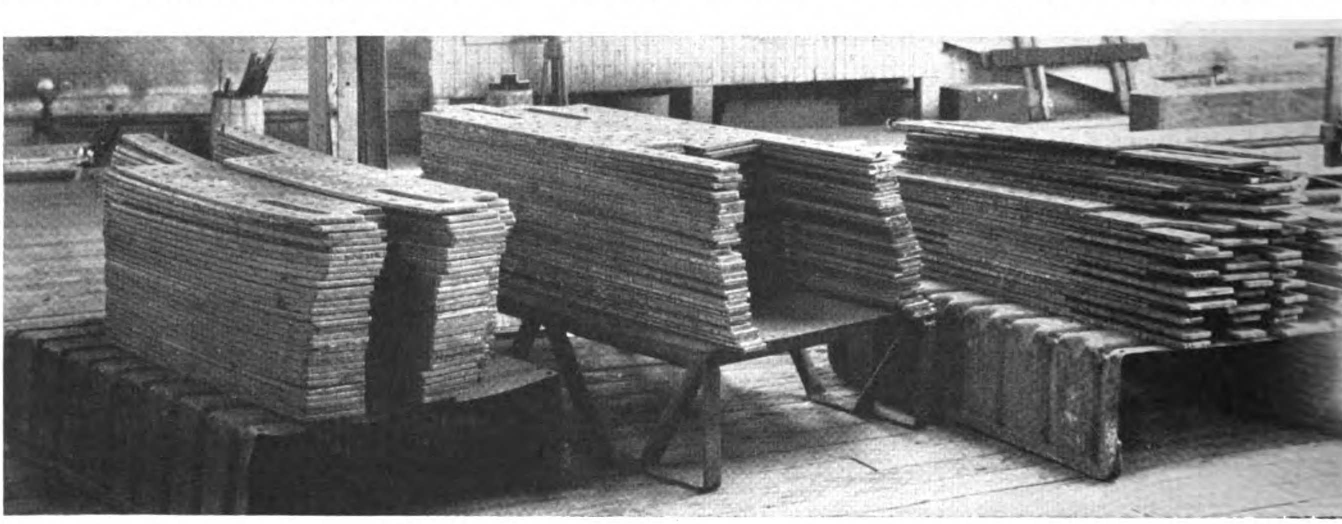
The draft-sill reinforcing plates, shown on skids in one of the illustrations, are first punched on this machine and subsequently bent, ready for application to the car center sills. Many small dies are made in the local shop where production warrants the expense, and such parts as running-board brackets, 'number-card holders, plywood ceiling supports for freight cars, etc., are turned out quickly and at low unit cost. All pressed angles, tees and channels are formed in this machine, which bends ½-in. open-hearth steel 10 ft. long; ⅜-in. steel, 16 ft. long; ¾-in. steel, 8 ft. long; and 1-in. steel, 6 ft. long. One particularly ingenious die manufactured in the local shop and used in this brake makes it possible to manufacture end filler clips, in quantities, these clips being cut from band iron, punched and bent in a single operation at a rate of 30 per min. These clips are made in two sizes, ⅛ in. by 2 in., and 3/16 in. by 3 in. The production of 30 per min. cannot be quite sustained throughout an 8-hr. shift, owing to the fact that the band iron is supplied in strips of a relatively limited length and there is a small amount of lost time between the forming of the last clip on one strip and placing a new strip in the machine. While even this small delay would probably not be permitted in an automotive production shop where certain parts are required to be made in the millions rather than thousands, it is not a factor of practical importance in this particular railway-shop operation. The average production of at least 1,200 end filler clips per hour is more than adequate to meet all railway shop requirements.

In the work of forming threshold plates, previously referred to, thirteen 11/16-in. holes and two 1-in. by 4-in. slots are punched in each 6-ft. section, this number of holes and slots being doubled when the threshold plates are punched in 12-ft. lengths.

Many pressings for passenger cars are made in this machine which was installed primarily for passenger-car work but has more than justified itself on account of the many unexpected uses developed in the manufacture of freight car parts. Among other special passenger shop jobs, large water-tank shrouds are formed in this machine. Where only a few are required, wooden dies, or forms are made, the upper and lower dies being bolted as usual to the machine base plate and ram by means of brackets. These water-tank shrouds are made of 16-gage Monel metal in sheets 7½ ft. wide by 16 ft. long. The curve on the bottom is a relatively large radius, with a short radius curve at either side of the car. In designing the dies, it is, of course, necessary to make all of these curves sharper than called for in the drawings so that when the metal springs back the sheet will have the correct shape and be ready for application in protecting the water tanks and other equipment under the passenger car bodies.

Cor-Ten steel roof sheets are given the familiar Union Pacific turtle-back roof shape in this machine. They are made of ⅛-in. stock in 16-ft. lengths, four sheets being required per car. Materials of all different kinds are bent in this machine; the principal precaution necessary in the case of metal such as aluminum alloy, is to be sure that too sharp a bend is not attempted.

The machine used in performing these operations was built by the Cincinnati Shaper Company, Cincinnati, Ohio, and is capable of accommodating work up to 16 ft. long and exerting a maximum bending pressure of 210 tons. The slowest speed of the machine is 10



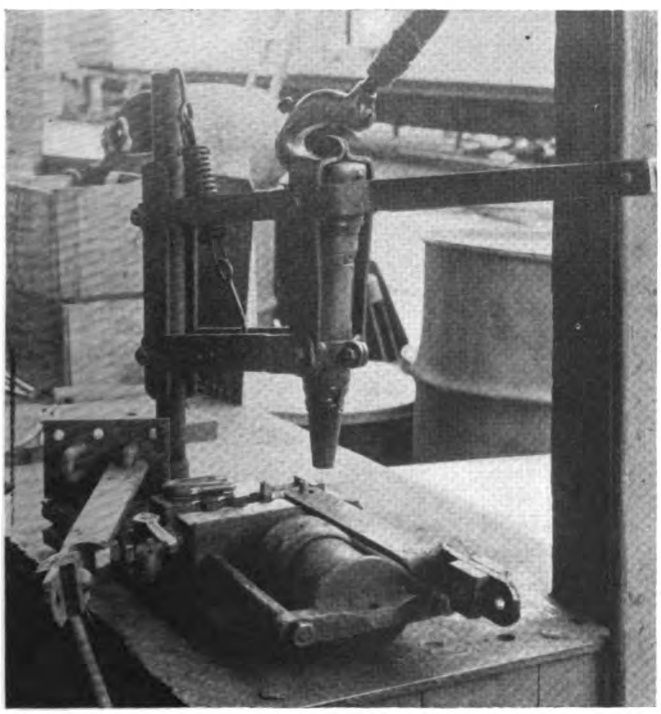
Draft-sill reinforcement plates which are punched and subsequently formed in the Cincinnati brake

strokes per min. and the fastest 30 strokes per min. One stroke at a time may, of course, be made by operation of the foot pedal, or the machine may be set for continuous operation. For use in punching operations numerous special dies are supplies by the manufacturer. The machine is said to have more than half paid for itself in the first year's operation.

Riveting Hatchway Door Holders

The hatchway door holders commonly used to keep refrigerator-car hatchway doors either sealed shut, or in the open position for ventilation purposes, consist essentially of four parts, namely a steel base plate about 3/8 in. by 4 in. by 6 in., in the center of which are two riveted U-bolts, one being used for locking or sealing purposes and the other serving as a hinge support for the 3/8-in. by 2-in. holder bar, or ventilating arm as it is sometimes called.

The problem of assembling these hatchway door holder parts and riveting over the ends of the U-bolts after they are passed through the base plate is not an easy one to solve and the work involves considerable difficulty unless a suitable holding and riveting tool is available. A fixture developed for this particular job at one large western railway car shop is shown in the illustration. It consists essentially of a vertically operating air hammer, suspended above a pair of die-blocks which hold the U-bolts firmly and also support the ventilating arm and the base plate during the riveting operation. The fixed half of the die is firmly secured to the work bench and supports a 4-in. air cylinder which operates the moving half of the die. The air hammer is held in position by means of a pantograph which swings about a vertical 2-in. pipe section set in the work-table top. The upper arm of the pantograph is extended to form a handle or operating lever for positioning the air hammer over the U-bolts and applying pressure during the riveting operation. The weight of the air hammer is balanced by a spring so that it normally stays in the upper position.



Convenient device used in riveting the U-bolts in refrigerator car hatchway door holders

The die consists of two steel blocks 2 in. thick by 4 in. wide by 9 in. long, recessed to hold two U-bolts at just the proper elevation for heading or riveting the ends after application of the base plate. Inasmuch as one of these U-bolts must be passed through the end of the holder bar, the upper surface of the die blocks is recessed at the right to a depth equivalent to the thickness of the holder bar. This enables the base plate to be fitted over the ends of the U-bolts and the holder bar and rest flush on the upper surface of the die blocks during the riveting operation for this particular U-bolt. After application of this U-bolt and the holder bar, the other locking or sealing U-bolt is applied, using the recess at the left in the die block.

The illustration shows a separate U-bolt resting on the upper surface of the movable die block and an assembled hatchway door holder at the left.

Cleaning Large Stencils

The large stencils, now required to carry individual railroad slogans and other necessary information, including maps, frequently must cover almost half a car side and these stencils need be cleaned at least once, and sometimes twice a day in order to assure satisfactory results. The cleaning of such stencils constitutes something of a problem, which has been solved at the San Bernardino, Cal., car shops of the Atchison, Topeka & Santa Fe by means of the long stencil drip pan and other equipment shown in the illustration.

Drip pan used in cleaning large stencils at the Santa Fe car shop, San Bernardino, Cal.

The drip pan is made of 24-gage galvanized iron, 24 ft. long by 3 ft. wide by 6 ft. deep, stiffened with five small crossbars at the top which also serve to support the large stencil, held in an approximately vertical position by leaning against two posts, as indicated. The drip pan is equipped with a drain valve at the lower

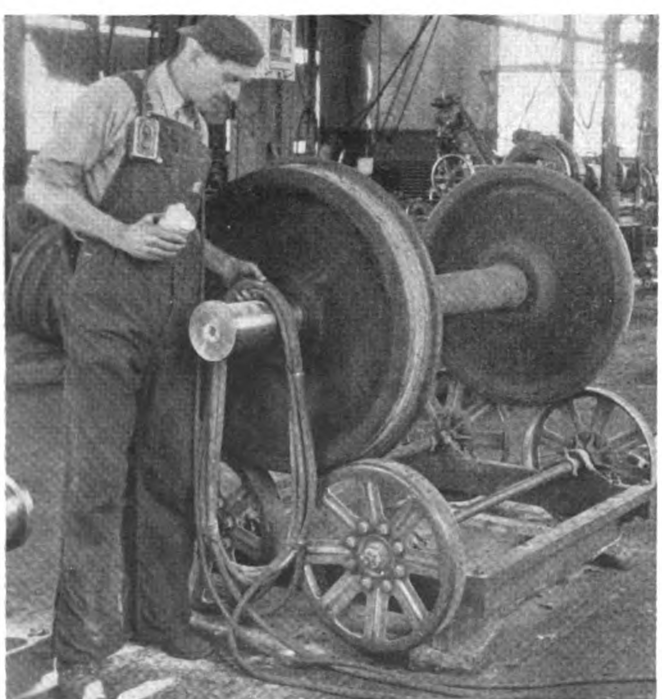
left-hand corner adjacent to the barrel of distillate which is used for cleaning purposes.

In operation, a handle brush is used to apply distillate to the stencil which is brushed until all traces of paint are removed. The excess distillate drips into the pan and is drained off through the drain valve for re-use until too dirty to serve effectively in cleaning additional stencils. Approximately one hour is required for cleaning a stencil of the size shown in the illustration.

Magnaflux Testing Of Car Axles

In the Magnaflux testing of car axles, special equipment is used at one of the principal car shops of a western railroad. Unmounted axles are placed between centers in an old engine lathe which has had the headstock removed and the carriage replaced by a magnetizing coil mounted in a cylindrical box on rollers which moves along the V-ways of the machine. An extra long tail-center extension of 14 in. to 18 in. is required at one end, so that the magnetizing head, in one extreme position, will clear the end of the axle and permit inspection of the entire axle. The magnetizing head is, of course, connected by electric leads to the Magnaflux Type K3 testing machine which operates on 440-volt, 60-cycle, 60-amp. electric current.

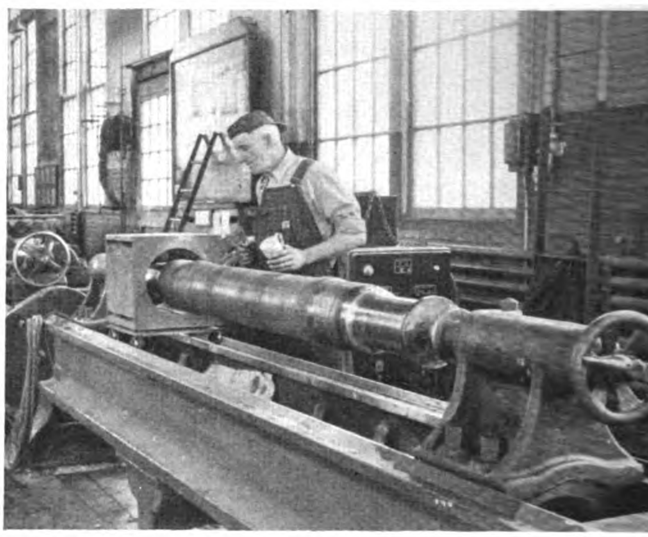
Before attempting to test axles, they are cleaned with a distillate wash and wire brushed with a high-speed air motor to remove all dirt and rust or scale and thus facilitate a careful inspection for possible progressive cracks or surface defects. When necessary, the axles are also dusted with a light coat of unslacked lime to remove all traces of oil and moisture. Under favorable conditions sandblasting is the best method of cleaning, but sandblast equipment is not always available. When this method is used, a guard must be placed over the journal and dry collar to avoid damaging the journal.



Inverted push-car frame and wheels used in the Magnaflux testing of axles with mounted car wheels

The axle is sprinkled with Magnaflux powder for the entire length, a sheet-metal tray being used underneath to catch the excess powder which drops off. By moving the fully charged magnetizing head over the axle, any progressive crack or surface defect is then made evident, the broken lines of magnetic force causing the Magnaflux powder to be disturbed and give a visual indication of the extent of the crack. As a rule, most of the cracks are found just within the inside wheel fit. On large axles it is necessary to sprinkle and test the axle at three angular positions approximately 120 deg. apart. On smaller axles two sprinklings are adequate. The excess powder is brushed off the axle before each resprinkling and saved for re-use. From 32 to 38 axles are ordinarily tested on this machine in eight hours.

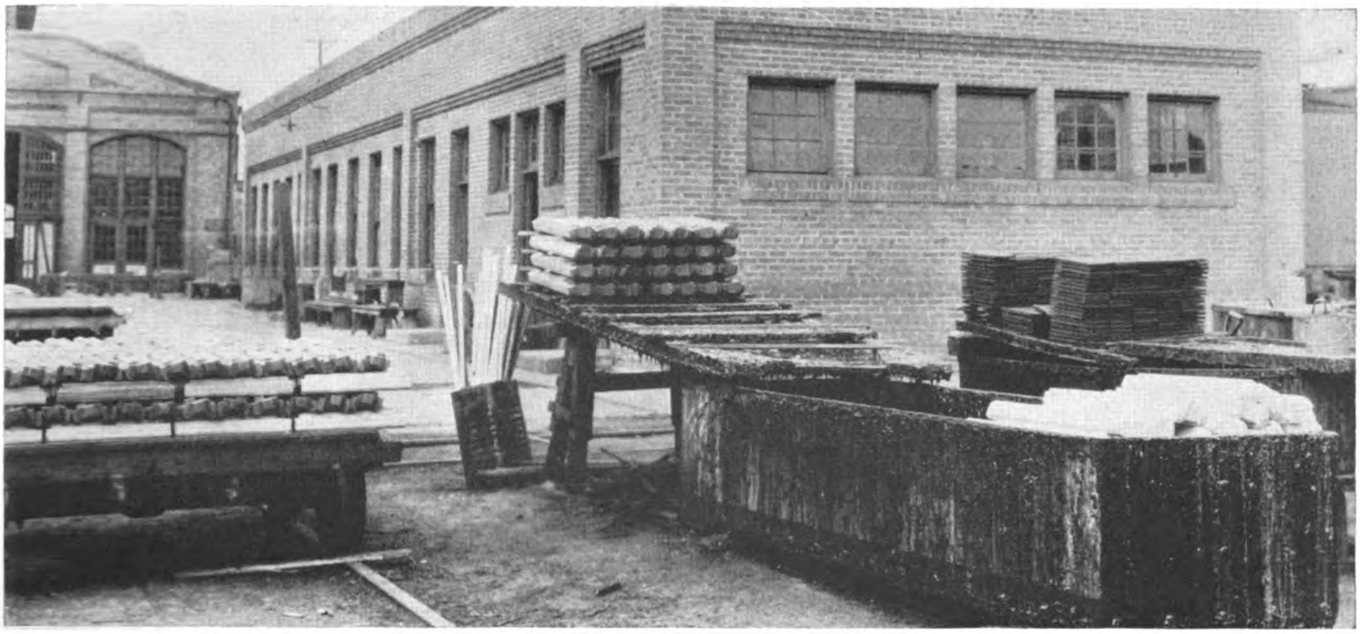
For testing axles with mounted car wheels, the inverted push car frame with close-set wheels is used to support and revolve the car wheels during the testing operation. The 20-in. push-car wheels, with axles spaced 23 in. apart, are mounted on roller bearings and have the flanges cut off with the oxy-acetylene torch so that the car-wheel tread rests on the treads of the push-car wheels. In testing the axle with mounted car wheels by means of this device, five coils from the Magnaflux machine are placed over the journal or axle (between the mounted car wheels) and the powder sprinkled on so as to give an indication of any cracks or surface defects. The car wheels are then easily revolved and one or more additional sprinklings made as required to cover the entire circumference of the car axle. The axles of all mounted car wheels handled through the shop are thus given a careful Magnaflux test, the same cleaning method being used as that previously described.



Old lathe bed stripped and equipped with extended centers and a magnetizing head for Magnaflux testing of car and tender axles

Dip-Varnishing Wood Freight-Car Parts

The equipment shown in the illustration provides an efficient method of dip-varnishing any small freight-car parts which are made of wood and may require this kind of finish. As a matter of fact, the same method may be used in applying other paint finishes, but refrigerator-car parts such as floor-rack slats, bulkheads, side-door rails, hatch plugs, etc., are usually finished with



Equipment for dip-varnishing wood refrigerator-car parts of small size such as floor-rack slats, hatch plugs, etc.

one or more coats of clear, light varnish, as called for in the specifications.

Instead of attempting to varnish these parts by hand, which would be a relatively slow and laborious operation, the 3-ft. by 4-ft. by 24-ft. sheet-metal tank, shown in the right foreground of the illustration, is filled to a depth of 6 in. to 12 in. with varnish and the wood parts are simply thrown into this varnish tank. After being thoroughly immersed, the parts are piled on the drain board installed at one end of the tank, this board being pitched so as to drain all excess varnish drippings back into the tank.

When the parts are thoroughly dried they are easily moved to the hand push car, shown at the left of the illustration, for transportation to the storeroom or to the shop department where the parts are to be applied to cars.

Seat Covering of Box-Woven Plastic

A recent development in the field of plastic research is the production of colorful, box-woven Saran seat covers by the Heywood-Wakefield Company, Gardner, Mass. This development has been introduced to the transportation industry by the New York City Board of Transportation which placed in service a subway car equipped with seats covered with this material.

Among the advantages claimed for the seat covers is the ease with which they may be cleaned. Saran is non-porous. The dirt is confined to the surface and cleaning is a simple operation requiring only soap and water. Another advantage is the absence of splitting or cracking in this new material. A major annoyance with fibrous seating materials, due to cracking and splintering, is the damage done to passengers' apparel. Because of its toughness, smoothness and flexibility, this plastic eliminates any such damage. It is available in an extensive range of colors.

Saran is the name given to the fabricated forms of a group of new thermoplastic resins, technically known as vinylidene chloride, produced by the Dow Chemical Company, Midland, Mich. This particular family of plastics, being chrystalline in character, offer extreme flexibility combined with high tensile strength. Under tests conducted in the Dow laboratories this plastic has been flexed more than 250,000 times without breakage and experimental strands can be produced with a tensile strength as high as 100,000 lb. per sq. in. It is highly resistant to water, corrosive acids, alkalies, inorganic and most organic solvents. It will not burn.

This synthetic rattan is produced by an extrusion process into one continuous strand which speeds up the weaving and results in a finer finished material than is possible with the short lengths of natural materials. A contribution by Heywood-Wakefield technicians is the pre-forming of the seat corners after weaving.

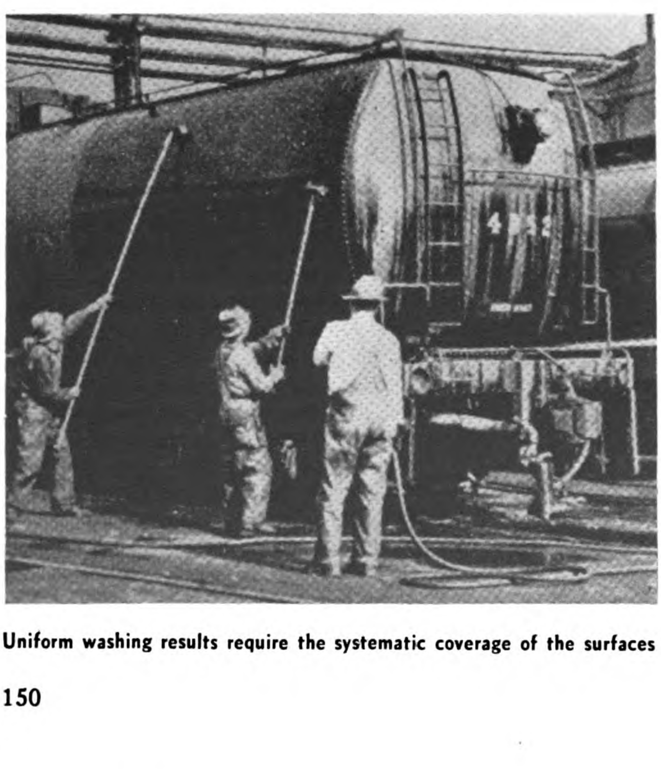
Seats upholstered with Saran in a New York City subway car

Oakite Develops Safe Passenger Equipment Cleaner

An important part in the maintenance of the attractive passenger cars now in service on the railroads is the care given to the colorful exterior finishes. During the last year, tests have been made by Oakite Products, Inc., New York, in perfecting a material for washing train equipment which is given comparatively frequent washings. It has resulted in the development of Oakite composition No. 70, a material possessing sufficient wetting out and cleaning properties to penetrate and remove the foreign matter encountered in most sections of the country. Besides these characteristics, the composition meets the demands of safety as it can be used at concentrations two or three times that which is ordinarily required without affecting the car finish.

In the actual use of this cleaning material, the best practice is to apply the solution by means of brushes and allow it to soak for five minutes to a half hour, depending upon the conditions encountered. The washing routine can be varied readily so that the longer soaking period does not interfere in any way with the progress of the work. It merely means that a larger area of the coach is covered before returning for the final rebrushing and rinse. The length of the soaking period with a water solution depends upon the ability of the solution to cling to the surface and the time that elapses before the solution dries. A long soaking period is not practical in many instances because many materials, even those that are free rinsing when in solution, are no longer free rinsing once they have dried out upon the surface to which they have been applied.

A dried out solution has no cleaning effect on the surface on which it rests, but if the material remains free rinsing, as does Oakite composition No. 70, a great deal of difficulty is prevented in those instances when drying occurs more rapidly than expected or when the washing procedure is interfered with for some reason or other. Even when applied to a warm engine jacket, for instance, where drying is extremely rapid, the deposit can be readily rinsed away, a result which would be impossible with most materials under similar circumstances.



Uniform washing results require the systematic coverage of the surfaces

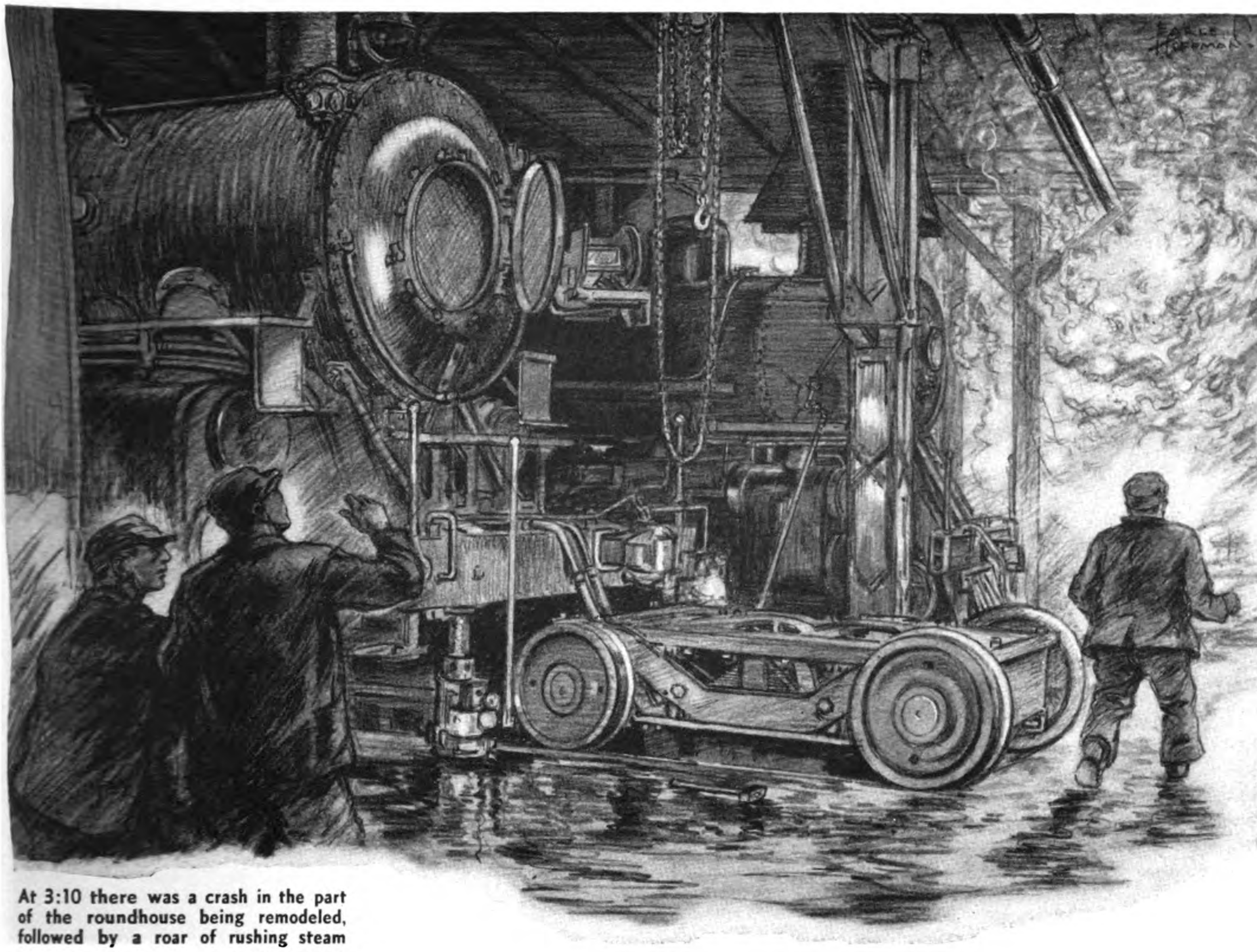
Washing a car with Oakite materials—The line of demarcation between washed and unwashed areas may be seen at the extreme right

In discussing the effect of cleaning solutions on synthetic finishes, it must be pointed out that the term "synthetic finish" is somewhat of a misnomer because often the resin alone is the only synthetic component of the material. The synthetic finishes, like the old-time finishes, may be classified as varnishes or lacquers. The lacquers contain nitro cellulose whereas the varnishes do not, but in either case, the material contains a relatively large amount of vegetable oil such as soy beans, tung oil or the dehydrated castor-oil products, etc., so that what is known as a "long-oil" type finish is obtained. The reason for the latter is that the finish must be durable, flexible and have the ability to withstand vibration.

The chief synthetic resins which are used are Glyptal (Alkyd) and the phenolic type, the former being used extensively. The presence of a relatively large amount of vegetable oil in the film and to a lesser extent the Glyptal resin tend to make these finishes more susceptible to alkali than if a "short-oil" material is used. In some cases the pigment may be affected by the type of cleaning compound but this occurs more generally with acid materials than with alkaline materials.

A neutral soap should give a pH of a little over nine but many soaps contain free alkali causing them to have a high pH and thus more liable to attack the finish. The pH of Oakite composition No. 70 is about the same as that of a neutral soap but because of certain ingredients, the tendency to attack finishes is less than that of a neutral soap.

With this explanation, the advantages of composition No. 70 are summarized as follows: Its pH is low and therefore it will not have a detrimental effect on many finishes that the more alkaline materials would have; the material is so compounded that even though the pH is low, good detergent action is obtained through emulsification and absorption; it tends to bring out the original color of the surface and to impart gloss to it; the material rinses very easily even though it is allowed to bake on the surface at a high summer temperature or if it is exposed to sub-freezing temperatures; it dissolves easily and completely with the exception of an insoluble ingredient which stays in suspension very well; the material is easy to apply and adheres very well to the surface, giving a relatively thick film which helps in the scrubbing, and the material will not harm the skin or clothes of the operators.



At 3:10 there was a crash in the part of the roundhouse being remodeled, followed by a roar of rushing steam

ALL IN SEASON

by **Walt Wyre**

THE S. P. & W. roundhouse at Plainville was built like a mud-dauber's nest, by making additions as required to meet current demands. Mud-daubers, though haven't increased in size in the passing years, but locomotives have, and each succeeding addition to the Plainville roundhouse reflects that trend which accounts for the various lengths of stalls in the roundhouse.

The original roundhouse—four stalls and a lean-to for a machine shop—became too small for use nearly twenty years ago. The stalls were lengthened and a new machine shop built. These four stalls were made eight feet longer than the six adjoining stalls which were the first to be added to the original roundhouse. Three other sections of the roundhouse have stalls of varying lengths which spoils the old joke of looking for a corner in a roundhouse. Each different length of stalls makes an offset and at each offset there is a corner; not exactly corners, either, for corners are square and the portable crane has rounded all of the corners that project inward by knocking bricks off with tires, main rods, and sometimes the crane itself.

The six stalls of the second oldest section have been too short for much practical use ever since the S. P. & W. scrapped the 1700's they were using for freight service. Officials have been considering lengthening the stalls and raising the roof for several years. Last spring it was decided to do it. Perhaps a section of the roof falling in may have had something to do with speeding up the decision.

Jim Evans, the roundhouse foreman, was delighted when he learned the stalls were to be extended. Of course he did not expect work to begin immediately, but when Hallowe'en and both Thanksgiving days passed without any indication of the work starting, the foreman began to get uneasy. "Waiting until cold weather, I guess, like they always do," Evans commented.

The first week of December went by and Evans, busy with so many other things, had almost forgotten about the stalls to be lengthened, until one Monday morning a gang of men showed up at the roundhouse. "We are going to start tearing out the front half of the six stalls that are to be lengthened," the foreman of the gang told Evans, "and we will start on the roof."

"That means I'll have to get the engines out of those six stalls," Evans said.

"No," the gang foreman replied, "just out of the three stalls on the north side right now. We're going to start on that side first. It might be a good idea to have the other three stalls empty day after tomorrow."

The weather was nice and clear and warm for the time of year. The workmen made good time ripping the roofing boards from the roundhouse. Evans watched somewhat uneasily when the men started removing the heavy smokejacks and lowering them to the ground, but the job was handled carefully and without endangering any one. In three days the six stalls had no roof on the front half and Evans was without stall room for part of the engines. On the fourth day the men started taking down the heavy timbers that had supported the rafters of the roof and all of the roundhouse employees were cautioned to stay out of that section of the roundhouse.

THAT afternoon the fire-builder started a fire in the 5082 at 3:00. The engine was called for 4:15 and the fire-builder had little enough time to get the engine hot. At 3:10 there was a crash in the part of the roundhouse being remodeled, followed by the roar of rushing steam. At the same time the blower stopped on the 5082.

A boilermaker working in the hot fire-box of the 5090 rushed to the fire door and stuck his head out gasping for air. He managed to climb out and dropped down on the fireman's seat box. As soon as he got his breath the boilermaker started cussing his helper for letting someone turn off the blower. The helper denied the charge. He had been watching all the time and no one had turned the blower off.

Evans heard the roar of rushing steam and did a little rushing too to see what had happened. One of the heavy roofing timbers had fallen on the blower line which passed through the six stalls being lengthened and had broken the six-inch pipe at a joint. By the time Evans got there, someone had already closed the valve to the blower line.

It took forty-five minutes to rig up a temporary blower and there was thirty-five minutes delay on the 5082. Evans made some choice caustic remarks about workmen that dropped timbers on a pipe line which did no good except to relieve Evans' feelings somewhat.

After the roof and timbers were torn down, the gang of workmen started pulling down the brick wall.

"Say," Evans said to the foreman, "I thought you were going to build the new wall before tearing down the old one."

"That was the original plan," the foreman replied, "but my boss decided to tear down everything that comes out and get it out of the way before starting on the new work."

"What if it turns cold?" Evans asked. "You know we are already overdue a cold spell."

"Don't know; that's the way my boss said do it, and that's the way I'm doing it. Maybe the weather will stay nice until we get the wall built," the foreman said hopefully.

The weather at Plainville can change as rapidly as a woman's mind in a millinery store. At 4:30 in the afternoon, Jim Evans was running around in his shirt sleeves and wishing that he had waited awhile before putting on long-handled underwear. A low-lying blue haze in the northwest was the only indication of an impending change of weather. By 5:00 the sky was overcast with clouds and the thermometer had dropped almost to freezing.

"Looks like it might be cold enough to freeze the ears off a brass monkey before morning," John Harris, the clerk, remarked as he was preparing to call it a day and go home.

Then, just to show that it could be different, the weather changed again and it began to rain. When the sun slipped behind the horizon, the mercury dropped about two degrees and the drizzle began to freeze. The rain continued to fall and freeze wherever it hit. Ice began to accumulate on wires.

"If this keeps up, there'll be some wires breaking before morning," Evans told the night foreman when they changed shifts at 7:00.

"It does look bad," the night foreman agreed. "Guess I'd better get the engines out that are to run in case the electric power should go off."

All night long the drizzle continued to fall and freeze. Wires sagged under the weight of ice. Some of them broke, but the line to the roundhouse stood up.

When Evans got up next morning it was still too dark to see outside. He snapped a switch, but there was no light. "Must be burned out," he said to his wife, and tried another light. It wouldn't burn either. Evans dressed in the dark while his wife prepared breakfast by the light of a flashlight.

When he went outside, Evans could see why there were no lights. The wires from the pole to his house were broken. Trees in the yard were borne down to the ground with their burden of ice that still continued to accumulate.

On the way to the roundhouse, the roundhouse foreman had to drive slowly and with many detours to avoid tangled wires and fallen poles that blocked his way. Once he stopped barely in time to avoid a light pole that toppled down across the street.

"Say, this is the worst I ever saw," the night foreman said when Evans entered the roundhouse office.

"Yes, and getting worse. Have we still got power?" Evans asked.

The night foreman nodded, then said, "I talked to the manager of the power company about an hour ago. He said they would try to keep us going if possible. They have cut off the current everywhere except our line and the one in the business section.

When the roundhouse power line stood the strain all day, Evans thought perhaps it would not give way. It was sagging in long loops from bending poles, but unbroken when he went home that evening after a day that moved the gray of his temples nearer the bald place on top of his head. He knew it would be bad enough at best for the night foreman and tried to get all of the engines worked. Part of them had to be worked outside because there wasn't room in the roundhouse.

About ten o'clock that night a cold wind from the northwest drove the drizzle away and playfully pushed over most of the few electric lines that had stood the strain of ice. The night foreman had already collected torches, lanterns, caboose lamps, and everything else possible for illumination when the roundhouse lights went out at eleven o'clock. At the same time the hostler helper operating the turntable was turning the 5087 to put the engine in the house. The turntable stopped midway between tracks halfway from the empty stall in which the engine was to be run. The hostler went in search of the night foreman.

"Get a cable and pull the table around with an engine," the foreman told the hostler.

"Which engine must I use?" the hostler asked.

"Any of them outside that's hot," the foreman said in a tone that indicated that he didn't have room in his mind for any more trouble.

About two o'clock in the morning the norther hit and the mercury tried to imitate a "Stuka" bomber. The northwest wind whistled in through the gap where the wall had been torn down and through the rest of the roundhouse.

When Evans arrived on the job at 7:00, all of the engines that had come in since before midnight were

outside. The night foreman, hostler, and hostler helper were all busy trying to keep the engines from freezing up.

The night foreman, his eyes red, nose blue, and teeth chattering, came into the office. "I tried to call an extra hostler and helper," he said, "but the telephone wires are all down and I didn't have any one to send. There's nothing written in the dope book—didn't have time—just write one helluva night and sign my name. The 5091 will have to have a new pair of trailer wheels before she can run," the night foreman added.

"What time did the power go off?" Evans asked as he wriggled into a heavy sheepskin coat.

"About eleven o'clock. Guess it'll be off two or three days," the night man replied.

About nine o'clock a caterpillar tractor was sent to the roundhouse to pull the turntable around, but no means were available for operating other machines. As a result not a great deal of repairing could be done, but the men were kept busy watching engines and trying to keep warm.

Most of the work had to be done outside but it was almost as bad in the roundhouse. Heater blower fans wouldn't run and if they had the blustering north wind would have made sport of the gentle warm breeze. At every place where water dripped it froze and icicles hung from leaking pipes. An engine blown down and filled with hot water had frozen pipes before the fire-builder could get steam.

Engines that were in condition to run at all were serviced and turned. Ones that were not in condition to use were run in the house until by the middle of the afternoon serviceable engines were about all used up. One ray of sunshine in the mad melee was that the telephone wires being down prevented the dispatcher calling the roundhouse office. However, the "train delayer" kept a messenger hot-footing back and forth.

At 2:15 the messenger came in with a request from the dispatcher for an engine to run east with just a caboose.

"It's a wonder he doesn't want to doublehead it," the clerk said. "He has doubleheaded everything else."

"Might not be a bad idea at that," Evans commented. "It'll take two of the engines I've got left to get over the division, light or otherwise. I'll let you know what engine when you come back," he added to the messenger.

Evans wasn't joking when he said there weren't any extra engines. The best one left was the 5091 and the flange of the left trailer wheel was sharp enough to use for a razor. The engine had been run in the house and spotted over the drop-pit for the wheels to be changed when and if electric power was available.

Evans checked over the engines and there wasn't one available for the extra that could be run. He went into the machine shop where most of the machine men were grouped around the gas forge that the pipefitters use. "Let's go out to the drop-pit a minute," he said to two of the machinists. On the way to the drop-pit he picked up two more machinists and two helpers. "One of you bring an 18-inch pipe wrench," the foreman said to the machinists. "Now, what we've got to do," Evans explained when they reached the drop pit, "is to run this thing by hand. Let me see the pipe wrench."

The foreman took the wrench and tried turning the cross shaft that was geared to the motor. The shaft turned fairly easy, but the motion of the table was almost imperceptible. "It's going to be awfully slow, but it can be done," he said. "Get two more wrenches and try to keep it moving pretty steady. I'll send two helpers and one of you machinists can work on top. Tell the crane operator to bring in a pair of wheels."

When the foreman had left, the men grumbled a bit about the job, but they went at it with a will and were soon joking about the three jackass-power drop-pit. In a short time they had learned to coordinate the work so that the shaft was in motion continuously, but the movement of the drop-pit table was still discouragingly slow and it took almost three hours for four machinists and four helpers to change the trailer wheels which should be some kind of record. However, the engine was made ready to run, which was the main thing. Besides, the men would have been doing little else except trying to keep warm and cranking the drop-pit accomplished that.

Getting an engine turned and across the table was slow work with the tractor for power. It was almost impossible to spot the table for a track without considerable jiggling. There would have been some terminal delays if the trains had not all been running late. Telegraph, telephone, and signal wires were all down and trains were running on the time card. The superintendent and trainmaster helped some of the inferior class trains over the road carrying orders by automobile on the highway that parallels the railroad. Altogether it was a sweet mess, the kind that makes railroaders favor a younger retirement age.

When H. H. Carter, the master mechanic, came down that morning, he immediately got in touch with the power company to try to find out when service would be resumed. The answer he received was very indefinite and unsatisfactory. "Too much ice on wires and poles for men to do much," the superintendent of the power company said. "I've sent for all of the available linemen. Our local gang is working to get service to the hospital. The business section will come next, then the schools. It will probably be four or five days before we can get a line run to the roundhouse."

"What if we run our own line?" Carter asked.

"That'll be fine," the power company official said.

While Evans was wrestling with the problem at the roundhouse, the master mechanic, electrician, and a gang of men were knocking ice off wires, straightening up leaning poles and replacing broken ones. In most places wires between poles that were not broken had sagged so low that they could be reached with a short piece of pipe. The ice casing on poles was dislodged by jarring the pole with a heavy sledge. Carter, afraid that any one else would get hurt, did most of the sledging. It was surprising how agile a man of his age can be when two or three hundred pounds of ice start falling in his direction. He would hit a pole and jump back. One time his foot slipped. He fell face down on the frozen ground and skinned his nose. Just as he started to get up, a chunk of ice him him between the shoulders and down he went again. By night he was stiff and sore as one of Joe Louis' sparring partners after a hard workout.

The night foreman showed up a little early and Evans went home to supper but returned to the roundhouse in about an hour. It had been bad enough all day, but night and no lights made it worse. The wind was still whistling from the northwest. It was too cold to work outside and little better in the open roundhouse. Improvised salamanders made of metal barrels with the top cut out provided a lot of smoke and little heat. Men standing by them would freeze on one side and bake on the other while tears rolled down their cheeks from the smoke in their eyes. Evans stayed on the job until 10:00 then left it with the night foreman.

Next morning the weather was better but conditions weren't, especially the engines. The wind blew itself out sometime in the night and although the thermometer still stood around the nothing mark, it didn't seem so cold.

The tractor was still pulling the turntable, though, and every engine in the house was tied up for machine work. There were two serviceable engines outside, both called.

At 10:30 there wasn't a single serviceable engine at the terminal. The dispatcher had just sent word by a messenger that he wanted an engine at 12:30 and another at 1:15. The roundhouse clerk found Evans.

"What must I tell him?" the clerk asked.

"I'll go tell him," Evans said.

The foreman and clerk went to the office together where the messenger was waiting. "Tell the dispatcher that there ain't no more engines and won't be until we get electricity, unless an engine comes in that is in condition to run."

At that moment the electric light over the clerk's desk flashed on then went off. It came on again and stayed on.

"Wait a minute," Evans said as he dashed out of the office and headed to the machine shop. In the machine shop the foreman pushed the starting button on a lathe. The motor started. He rushed back to the office. "Tell the dispatcher to hold up a little on that first engine and we'll have it for him. It'll be the 5086."

At noon the contractor had a gang of men working on the roundhouse again cleaning out debris where the new wall would be. "The bad spell of weather delayed us a little on the job," the contractor said, "but guess we can always expect a little trouble."

"Yeah," Evans replied dryly. "If you had been around here for the past two days you wouldn't have been disappointed. I've been railroading quite a while, and there's one thing I want to see before I retire."

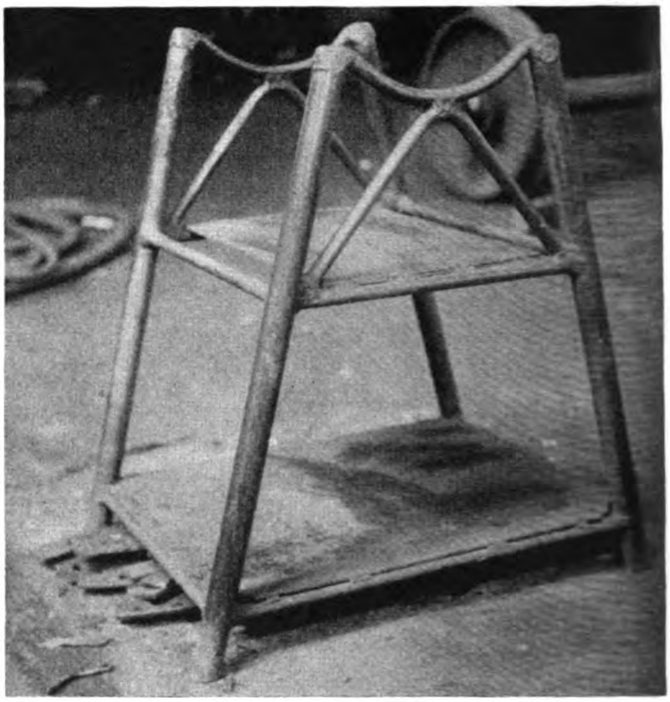
"What's that?" the contractor foreman asked.

"A roundhouse remodeled in the summer time."

Setting Tires In The Small Shop

Applying tires in the small shop or the enginehouse is a difficult job that can be simplified by the use of the devices shown in the accompanying illustrations. One of the first requirements is a suitable stand on which to placed the mounted wheels. The welded pipe stand shown is made from 1½-in. pipe of such width as to permit clearance for an axle from which the driving boxes have not been removed. The radius of the curved top of the stand is slightly greater than the diameter of the largest journal to be supported.

Chains are often used to pick up a tire when placing it on a wheel center but a more convenient way is to use a clamp such as the one shown. This clamp is simply a piece of heavy material which can be flame-cut to size. The two ends are drilled and tapped for the set screws which hold it on the tire. The hole at the top center is 1½ in. in diameter and the hook is made of 1-in. round bar. One end of the hook goes through the hole in the clamp and the other fits over the crane hook.



Welded pipe stand for supporting mounted wheels

The bracket for supporting the tire while it is being heated is made from ¾-in. plate with a ¾-in. U-bolt around the wheel spoke to hold the bracket against the wheel rim. When the tire is placed on the bracket the set screw is tightened to force the tire onto the wheel center. Then the ring heater is put in position and as the tire is heated and expands it will gradually slip onto the wheel center. A chain around a spoke with a bar through the chain can be used to force the tire onto the center or light blows with a sledge will help if it sticks. Once the tire is in the proper position two U-shaped clamps plus the set screw in the top bracket will hold it in position while cooling. The U-shaped clamps are made from 2-in. square stock, bent to shape and drilled and tapped for ⅞-in set screws. The clamps have three set screws, one of which is set against the inside of the wheel rim, another against the outside of the rim and a third against the outside face of the tire.

The bracket for supporting the tires while being heated, and the U-clamp for holding them in position are shown in the left-hand photograph; the clamp for lifting the tire is seen in the other illustration

Boiler and Shop Applications of

Oxy-Acetylene Welding*

The use of oxy-acetylene welding for repairing defective parts, restoring worn surfaces and fabricating new equipment

THE scope of applications of oxy-acetylene welding in the locomotive boiler field has broadened considerably since our committee's last report. New developments have been made that are remarkable for their economy of both time and cost.

Firebox Sheets

The repairing, patching and replacement of stayed firebox sheets including the firebox crown and side sheets, door, combustion-chamber and tube sheets by welding has long been an acceptable practice under the I. C. C. regulations. The establishment of this practice was based on the staybolted support of the sheets and the fact that the safety of these parts is not considered to be dependent primarily upon the welds by which they are joined. As a result of experience certain limitations have been imposed upon the extent of welding that is permissible in such staybolted sheets, such as the length of the welded patch seam, the extent of area that can be built up by welding over corroded spots and the location of welded longitudinal seams at any point higher than 12 in. below the top of the crown sheet. Despite these limitations, however, methods and procedures have been established by which the ordinary routine repairing of all of these parts, including removing and replacing of sections of the side, combustion chamber, door and tube sheets can be accomplished with the utmost facility and economy.

There are many cases where only a part of a side sheet is found corroded to the point of necessitating renewal and the rest of the firebox sheets, including the crown sheets, are capable of rendering further service. Cutting and welding permits that corroded part of the side sheet to be replaced with a minimum of delay and cost. With the oxy-acetylene torch or blowpipe, any desired portion of a sheet may readily be cut away and when the new sheet is formed and trimmed to the required shape and size, it can be welded in place of the part removed. Both the edges of the new sheet and of the plate left in place are readily veed by a cutting torch or blowpipe and then aligned for welding. The welds in these cases are of the single-V type and are made from the firebox side. The welding of such seams should be carried along continuously without stopping or delay when once started. This form of side-sheet repair has proved so successful during the past few years that it has caused a great reduction of complete firebox replacements.

New Fireboxes

When a complete new firebox is to be installed in a boiler it will be, in most railroad shops, a completely welded firebox with longitudinal welds between crown sheet and side sheets kept 12 in. below the level of the crown sheet. Transverse welds are permitted between the crown sheet and the door sheet and also between the crown sheet and the front flue sheet or combustion chamber. The sheets are accurately cut to size and formed before being brought to the erecting floor for welding. The veed edges of the sheets are then aligned and clamped in position with the proper spacing for welding; in some instances they also may be tack welded. The welding should be performed progressively in such a manner as to avoid bulging or warping of the sheets at the end of a seam and the welding of a seam, when once started, should be carried on continuously to completion without stopping or delay. The welds should be of the double-V type or the equivalent. The door-hole opening should be formed preferably to permit butt welding of the flanged-in edges of the sheets, or an offset or curved inserted sheet may be used with a butt-welded attachment to the door sheet and an arrangement for lap welding to the outer sheet flange. Where syphons are installed they should be fitted into the crown sheet with butt welds, while at the front flue sheet the necks of the syphons should be welded to the diaphragm plate with a corrugation to accommodate expansion and contraction.

Flue Sheets

Flue sheets also occasionally require renewal and it was formerly the practice to replace the entire sheet which involved a large amount of work in removal of connections, stays, diagonal braces, etc. Now it is customary to cut out and replace only such part of the flue sheet as has been affected by corrosion, or by overrolling of the flues. The inserted section is carefully fitted and the edges veed for welding in much the same manner as for a side-sheet patch. Where the section extends to either side, the edge of the sheet is flanged like the edge of a flue sheet and then the flange is bolted through the rivet holes into position which helps greatly in aligning the sheet for welding. Where an entire upper part of a flue sheet is to be replaced, the upper weld is located between the top row of flue holes and the bottom row of boiler braces. Where welds are carried across flue holes, the flue holes may be welded in solid and then drilled after welding or the holes may be trimmed by the gas-cutting torch or blowpipe to the approximate size and then reamed to the finished size.

Repairing Cracks

Cracks are successfully welded shut in firebox sheets provided it is possible to offset or otherwise deform the sheet on either side thereof so as to allow for the contraction after welding. These cracks often extend through staybolt holes, which tends to indicate that the sheet has been subject to stress at that point. In such cases it is more necessary than otherwise to bend or offset

* Abstract of the second part of a report presented at the annual meeting of the Master Boiler Makers' Association, October 22-25, 1940, at Chicago by a committee of the International Acetylene Association. This committee was composed of C. W. Obert, chairman, and J. H. Zimmerman, Linde Air Products Co., New York; F. C. Haase, The Oxweld Railroad Service Co., Chicago; R. F. Helmkamp and A. N. Kugler, Air Reduction Sales Co., New York, and E. A. Randall, Compressed Industrial Gases, Inc., Chicago. An abstract of the first part of this report appeared in the January, 1941, issue.

the sheet to a considerable extent before proceeding with the welding. The staybolt holes should be welded solid and then drilled after the welding has been completed. It is not desirable to repair a cracked sheet in this manner if the crack extends over two rows of staybolts in extent; when longer than this a patch should be inserted.

Welding Tubes

Extensive use has been made of oxy-acetylene welding in repairing and safe-ending both plain and superheater flues. In the case of plain flues, the prevailing practice has been to butt weld the safe ends whereas in superheater flues the safe-ends have been inserted and lap welded in certain instances. For butt welding, the safe-ends should be mounted and held in true alignment with the flue to be extended, the veed ends being separated by about $\frac{1}{16}$ in. Under these conditions very little reinforcement is permissible and it is, of course, essential that the welding be applied so as to leave the interiors of the tubes clear and smooth.

Pipe Welding

The welding of steel pipe, which has reached a very advanced stage of development in the industrial field, is rapidly coming into favor in locomotive erection and assembly work. While the piping used on a locomotive is of generally smaller size than that ordinarily encountered in industrial work, the importance of tightness has led to greatly increased use of welded joints and attachments. With welded joints and supporting brackets, dangerous sources of leakage are practically eliminated and the loosening of bolted or riveted connections is avoided entirely.

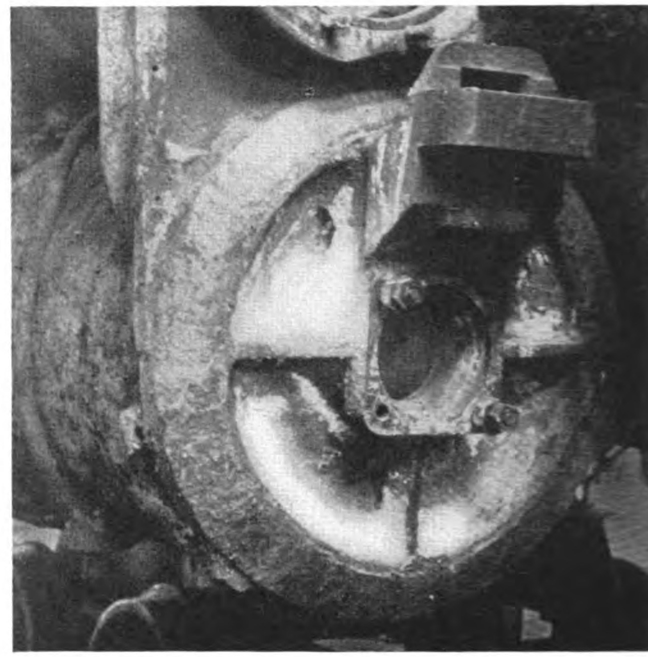
Most of the pipe-welding applications around the locomotive involve position welding but with customary oxy-acetylene welding practice, strong tight joints can be made of practically any size provided all sides of the pipe are accessible. The procedure in welding such pipe joints is somewhat different from that involved in the welding of plate and forgings but with the ordinary low-carbon steel materials usually encountered in pipe fabrication, no preheating or post heating is necessary. It is merely desirable to follow one of the established procedures that insures complete penetration without protrusions on the inside of the pipe and a reasonable amount of reinforcement on the outer surface.

Sheet-Metal Welding

Tenders, sheet-metal cabs, streamlining shrouds, etc., offer opportunities for oxy-acetylene welding applications that come within the range of the boiler-shop welding department. These embrace not only new construction of tender tanks and cabs, but also repairs and replacements of sheets, stiffeners or parts by sheet sections or patches. Oxy-acetylene welding permits of butt joints in the thinner gages with great facility, and this materially enhances the appearance of the finished work. In a few instances, tenders have been lengthened to afford greater capacity by gas cutting apart and inserting extensions of both underframe members and tank sheets by oxyacetylene welding.

Cast-Iron Welding

The welding and building up of cast-iron alloy, semi-steel and other gray-iron and gray-iron-alloy castings constitutes one of the major applications of the oxy-acetylene process. However, since the development of the bronze welding method, the use of cast-iron-alloy rods in welding and building up such parts is performed most extensively on gray-iron and gray-iron-alloy castings subject to temperatures higher than the melting point of bronze, such as superheater headers, dry pipes, throttle boxes, grates, fire bars, grate side frames, exhaust-nozzle stands, etc. Steam-hammer and forging-machine die blocks, forming dies and inserts and other parts, which must retain the original stiffness and direct characteristics of the gray iron or gray-iron-alloy material, are also welded or built up with cast-iron alloy rods. Surfaces of gray-iron castings, built up with the proper cast-iron alloy rod applied by the oxy-acetylene process, may be satisfactorily flame hardened by the newly developed oxy-acetylene flame-hardening process. Therefore, forming dies, forming-die inserts and many other parts made from gray iron are now being built up with cast-iron-alloy rod and flame hardened after the machining and finishing of the surfaces has been completed.



When the back cylinder heads are welded onto the cylinder castings, the welded joints will remain permanently leakproof

Bronze Welding

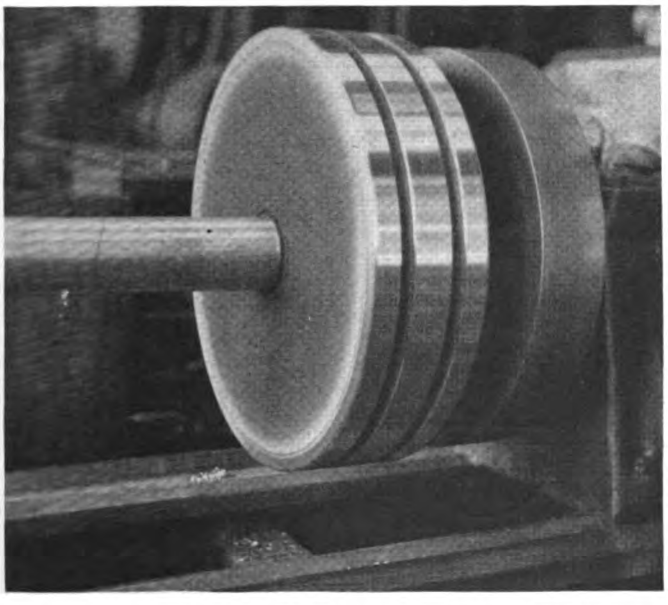
The relatively high strength and ease of application of modern bronze welding or brazing rods make this method particularly adaptable for the permanent joining or building up of gray-iron, gray-iron-alloy, semi-steel, bronze, brass, copper and certain other alloy parts, as well as parts made from various grades of steel. The bronze in the applied state is ductile, shock resisting and, as previously mentioned, of relatively high tensile strength. These factors, together with the ease of application and comparative low temperatures required for application has brought the bronze welding or brazing method into general practice on all railroads.

Bronze-welding applications in the locomotive shop include the following: The welding of broken gray-iron or gray-iron-alloy cylinder and saddle castings; air-pump castings; feed-water heater parts; feed-water-heater pump parts; certain stoker engine parts; bronze, brass or copper parts; the building up of locomotive piston heads; the building up of the wearing surfaces of cross-head shoes; the welding of steel back locomotive cylinder heads to gray-iron or gray-iron-alloy cylinder castings; the welding of gray-iron or gray-iron-alloy cylinder heads to steel cylinder castings and a very large number of additional parts which time will not permit mentioning.

Though the heat required to apply bronze rods is less than is required to apply cast-iron or steel welding rods, it is important that complicated parts, such as locomotive cylinders, air-pump cylinders, feed-water-heater castings, etc., be properly preheated prior to bronze welding to control the expansion and contraction stresses which may develop. In the instance of locomotive cylinders it is, of course, not necessary to preheat the part to as high a temperature as would be required if cast-iron-alloy rod were to be used but the same general precautions must be taken insofar as the actual preheating is concerned. A reasonably tight furnace must be constructed around the cylinder and provision made to preheat the unit slowly and evenly to the required temperature. After the bronze welding has been completed, the unit should again be evenly reheated, the furnace closed tightly and allowed to remain until the welded unit is practically cold. Make-shift methods such as improperly constructed baskets and light sheet metal or asbestos paper coverings should not be used in the preheating of complicated parts such as locomotive cylinders as it would be very difficult to control the preheating of the unit properly with a make-shift set-up of this kind. The bronze welding of a back locomotive cylinder-head casting requires the same precautions insofar as preheating is concerned as the welding of a break of similar proportion in the same location.

Another important use of bronze welding is for building up missing sections such as broken gear teeth or other parts that are broken off and lost, the building up or renewal of bearing and wearing surfaces, the renewing and refitting of threaded connections, etc. For gear teeth replacements and the renewal of wearing surfaces special compositions of bronze welding rod are available that will show remarkable strength and wear resistance in subsequent operation. In the building up of gear teeth it is common practice to form carbon blocks to fit the contour of the teeth and use them as molds between which the bronze rod is inserted and welded into place; this requires careful control of the building up operation in order that the molten metal may be deposited under perfect control.

In these building-up operations, preheating is often a great aid to the successful deposition of the bronze on the worn surface. Where the bronze deposit is to be applied to a journal bearing, it is often desirable to remove the



The bearing surfaces of this piston head have been built up by bronze welding—The bronze provides a high quality wear-resistant surface

Locomotive frames can be economically repaired by oxy-acetylene welding—The C-clamps hold the broken section in alignment

surface by a roughing cut or clip down to fresh metal, in order that a more secure bond may be obtained with the steel or iron base metal. Once the initial deposit is made upon this surface the bronze may be built up to as high an ultimate surface as may be desirable. These same considerations apply in the filling in of holes and bushings that have become worn, out-of-round or over size.

Hard Facing

Hard surfacing can be applied to advantage by oxy-acetylene welding the surfaces of superheater flues or smokebox parts that are subject to the abrasive cutting action of the cinders. The cinder guards that are attached to the goose necks of the superheater flues in the smokebox are examples; if these cut out too rapidly between shopping periods, it will be found advantageous to hard surface them—the same is true of the pointed ends of the return bends of superheater flues.

There are numerous wearing parts of the stoker mechanism that are worth while to protect by hard facing. Probably the most important of these are the wearing edges of the conveyor and elevator screws that are constantly subject to the abrasive wear of the coal. If worn too deeply, it is customary to weld on a strip of metal to true the screw and bring it up to size; then on the wearing edge a hard surfacing material is applied by the oxy-acetylene torch. The wearing edges of stoker shovels can be similarly treated. The results in added wear will pay a handsome return on the small investment in hard surfacing material.

Flame Hardening

An application of the oxy-acetylene flame that does not come under the cutting or the welding classifications, but is found to be increasingly valuable in the locomotive shop is that known as flame hardening. This is a process which utilizes the oxyacetylene flame to raise the temperature of the surface of an iron or steel body quickly to a point that will insure hardening of that area upon cooling. It is applicable to most steels that have a carbon

content of .35 per cent or more, the steels which are most readily hardened being those that have a carbon range of from .40 to .70 per cent. Steels with a carbon content higher than .70 per cent must be treated with great care in hardening to avoid surface checking or cracking. Pearlitic cast irons and malleable irons also offer opportunities for hardening to increase their resistance to wear.

Applications of flame hardening have been applied in many different ways, including the hardening of a localized area or spot, the hardening of a certain straight line area by progressive movement of the flame along that line and by the rotary progressive method which involves the rotation of cylindrical objects under the flame. In all of these cases the amount of input that is required is only that necessary to bring the temperature of the surface to be hardened up to the critical point after which the surface is allowed to cool by the quenching effect of the adjacent steel or iron. Such hardening is easily applied to either smooth or irregular contours and with very little practice the average operator can perform very satisfactory work. Care must be taken, however, properly to regulate and coordinate the movements of the flame in order to insure satisfactory results.

Locating Keyways on Locomotive Axles

A method of locating the keyways in a driving axle exactly 90 deg. apart is illustrated in the accompanying drawings. Except for an additional V-block, the required equipment is shown in Fig. 5. The two V-blocks are made of sufficient size to hold the largest driving axles and have holes, drilled and reamed to the same diameter, as indicated in the drawing. The hole through the V-face of the block must be on the center line of the block with its axis directly below and parallel to the bottom of the Vee. A rod is turned to have a nice fit in these holes and to this rod is fitted a sliding bushing which holds a surface gage. The bottom of the V-block is made with a lug to fit the slot in the table of the milling machine.

To use this device, the axle is placed on the V-blocks and clamped down. The milling cutter is centered as shown in Fig 1, where *B* equals *A* minus one-half the width of the keyway, and the first keyway is cut. Then, a combination square is set on the table, Fig 2, and the line *C* is drawn between two points on a circle scribed on the end of the axle. The axle is next rotated on the V-blocks until the line *C* is approximately horizontal as indicated in Fig. 3. Line *C* is made horizontal, Fig. 4, by turning the axle until the scriber passes through both intersections of the line *C* with the circle when the gage is set at one radius. The milling cutter is centered at the other end of the axle by the method shown in Fig. 1 and the second keyway is cut. This procedure assures the cutting of the second keyway exactly 90 deg. from the first.

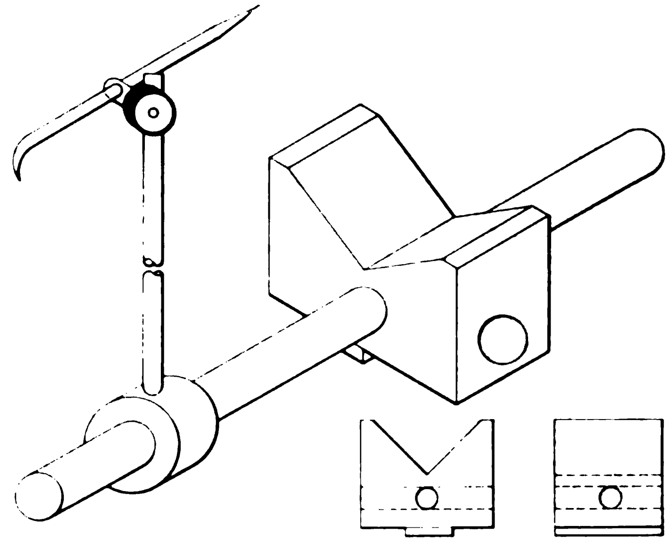


Fig. 5

Patch Designed to Enter Boiler Through Dome

The locomotive to which the patch shown in the accompanying drawing was applied came into the back shop for the sole purpose of having the shell patched at the water-pump bracket studs. The tubes had about two more years of service before they were scheduled for removal. The condition of the front and back flue sheets and the diaphragm plate was good.

The patch was designed to permit the inside welt to enter through the top of the steam dome. To allow a man inside the boiler plenty of room in which to work, a minimum number of flues were removed. The patch was laid out directly on the shell to make sure there would be no interference with studs and seams not shown on the boiler drawing. The location of rivets

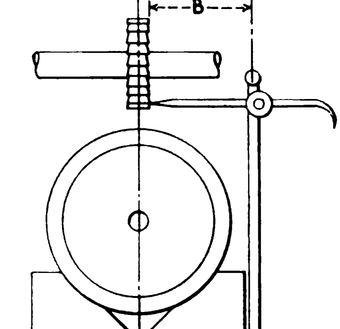


Fig. 1

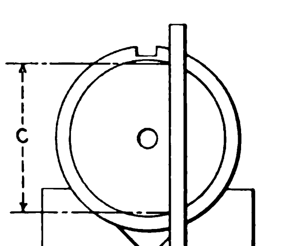


Fig. 2

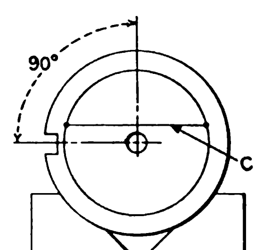


Fig. 3

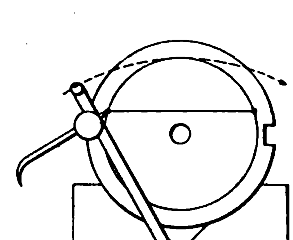
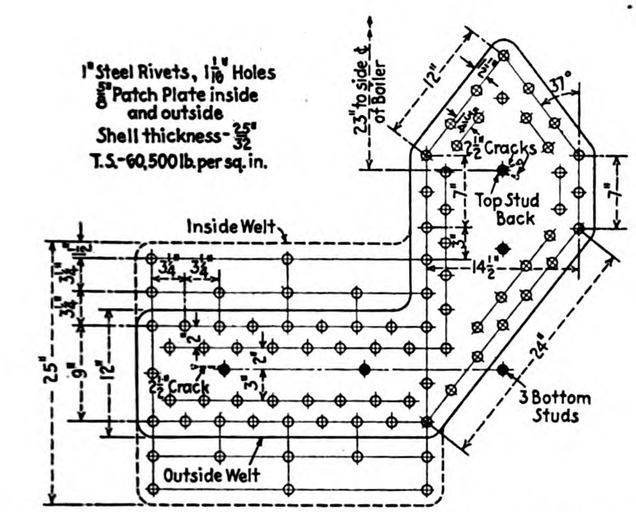


Fig. 4



Patch at the water-pump bracket studs shaped to permit the entrance of the patch through the steam dome

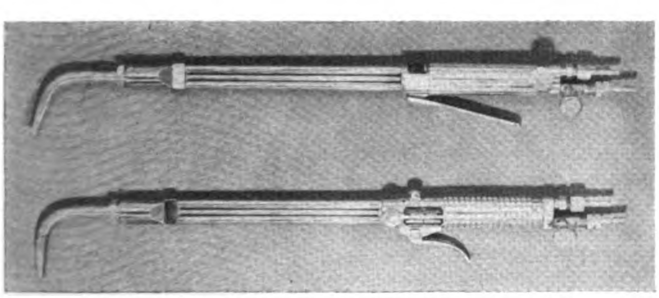
and spacing was made to meet the safety requirements prescribed by law.

It was deemed unnecessary to cover the lower back stud at the time the patch was applied. To do this would have required a larger inside welt which could not be entered through the dome without rolling the welt up to some extent. Such a procedure was not considered good practice.

Cutting Torches for Removing Riser Heads

In response to an increasing demand for greater convenience in removing riser heads from metal castings, Air Reduction, New York, has just introduced a new line of hand-cutting apparatus consisting of two torches and three tips. The new torches, styles 3180 and 9080, are of the straight-head type. Both have Monel metal heads and stainless-steel tubes for longer life; each is 21 in. in length. Cutting oxygen can be controlled by either a lever or a trigger and the type selected can be placed on the top, on either side, or on the bottom of the torch to suit the convenience and comfort of the individual operator.

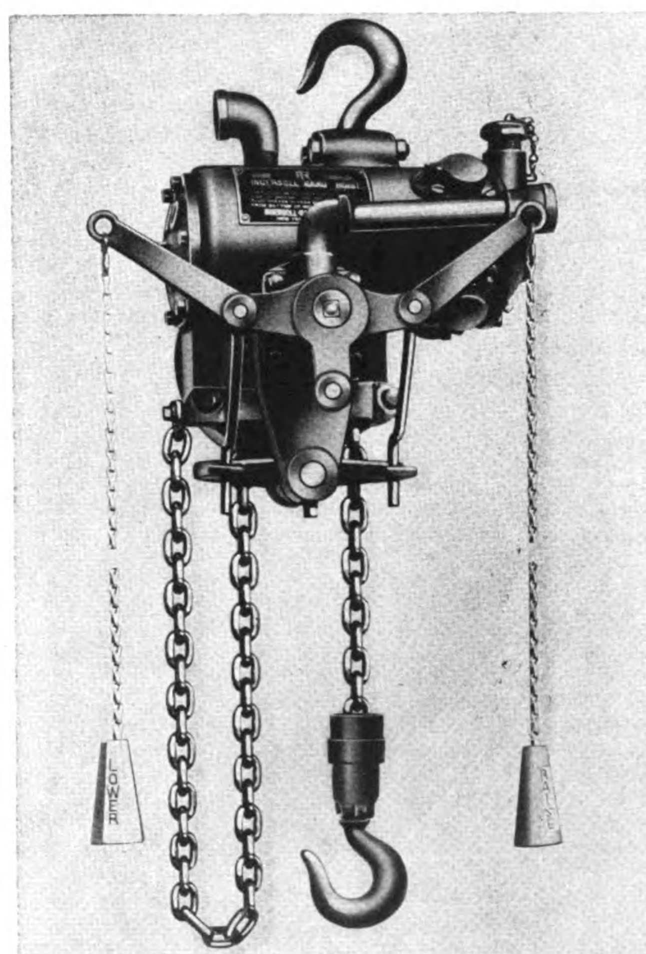
The cutting tips are known as Style 187, bent to 75 deg., Style 181, bent to 90 deg. and Style 191, which


These Airco torches and cutting tips are designed especially for cutting risers from metal castings

is a straight tip 7 in. long. Style 191 is not shown in the illustration. These tips are designed for greater maneuverability in the restricted area and cramped quarters frequently encountered in riser cutting. The shorter length from the end of the tip to the bend makes this possible. While designed especially for cutting risers, this apparatus may also be used successfully for removing rivets, for construction and repair jobs and as standard hand torches for regular and other special applications.

Air Hoist for Light Lifting Work

For hoisting light loads up to 700 lb., the Ingersoll-Rand Company, Phillipsburg, N. J., has introduced the Air-Bloc. It is a flexible, welded, link-chain air hoist designed for use in machine shops, assembly lines, maintenance shops and shipping and receiving departments. This hoist is available in three sizes identified as LC-3, LC-5 and LC-7 whch will handle loads of 300, 500 and 700 lb., respectively.



The Ingersoll-Rand Air-Bloc for hoisting light loads up to 700 lbs.

The Air-Bloc weighs less than 75 lb. and can easily be moved from one job to another. An automatic up and down stop control prevents damage to the hoist from over-run of the chain in either direction. Another safety feature prevents the load from dropping even if the air supply fails.

This hoist is powered by a four-cylinder radial type air motor which cannot be injured by overloading. Throttle control is sensitive, permitting easy and positive spotting of the load.

High Spots in
Railway Affairs . . .

De Luxe Coach Trains Popular

The coach trains that were placed in operation between Chicago and Miami, Fla., last December have proved so popular that it has been decided to continue their operation from April through May. It is even intimated that they may be continued throughout the year. These trains, which include the Dixie Flagler, the City of Miami and the Southwind, are operated over nine railroads which comprise three Chicago-Florida routes. Since December they have handled approximately 100,000 passengers, with consistently full loadings, and with bookings two weeks in advance. Although the fare is low, $41.85 for the round trip from Chicago, these trains are said to have earned close to three dollars a mile.

St. Lawrence Seaway Project

The Railroad Co-operative League of Michigan, Prudden Building, Lansing, Mich., has for a long time done a yeoman's job of combating the so-called St. Lawrence Seaway. Its aggressive educational campaign has "sold" the fallacy of this project to the people of Michigan. Recently it has been active in the distribution of several short pamphlets. One of these was a reprint of an article by Prof. L. H. Haney of New York University, entitled, The St. Lawrence Project—Why and Why Now. Another one prepared by the League itself is entitled, The Fictitious Glamour of the St. Lawrence, and still another discusses those segments of the population that will be injured by this project. The League is also distributing a fourth pamphlet, entitled, Expense Without Recompense which was prepared by the National St. Lawrence Project Conference.

Proud of Railroad Performance

The railroads can well afford to take pride in the high efficiency that they attained during the year 1940. It is briefly summed up in the following items enumerated by J. J. Pelley, president of the Association of American Railroads. (1) The average amount of freight carried per train was greater than ever before on record. (2) Freight was transported over the rails at an average speed never surpassed and approximately 62 per cent higher than 20 years ago. (3) Freight train performance per hour was approximately twice as good as that of 1921. (4) Freight locomotives attained a new high mark in average daily mileage. (5) Utilization obtained from freight cars was greater than ever before. (6) Fuel efficiency in freight service was higher than ever before. (7) Number of freight cars in need of repair was lowest on record.

Railroad Fan Visits Halted

The national defense program, which is now getting well under way, has made it necessary for the industries concerned to take measures to guard against sabotage. The railroads, because of the vital part that they play, have been tightening up their regulations in various ways, in order to safeguard their properties and operations. President J. J. Pelley, of the Association of American Railroads, recently made the suggestion that member roads withhold permission to inspect facilities, from aliens or citizens not duly accredited by appropriate governmental agencies. Apparently this was so construed that it was responsible for the cancellation of a projected trip of the Washington Division of The Railroad Enthusiasts, to visit the Southern's roundhouse at Alexandria, Va. Whether it will be responsible for eliminating all fan trips for the time being, remains to be seen.

N. C. & St. L. Going to School

"Although many things are required to run a railroad well," says Fitzgerald Hall, president of the Nashville, Chattanooga & St. Louis, "nothing can take the place of man-power in the form of highly trained men and women who are interested in the individual and co-operative effort that brings success to the company for which they work." This is the thought behind an extensive educational program that is being inaugurated by that road. It is intended to familiarize the employees with the function and operation of the railroad, and the course will consist of a combination of mail and class instruction. The part of the program now projected includes four sections—historical, corporate, organization and principles of transportation. It will be in charge of W. Way, Jr., with the title of executive assistant.

By Hook Or Crook

President Roosevelt, realizing that he could not get the necessary votes in the Senate to make a treaty with Canada for the St. Lawrence seaway, on March 19 announced that a joint agreement had been made with the Canadian government. This will be submitted to Congress and requires only a majority vote to make it effective. The project, of course, cannot be completed in time to be of use in the present conflict, unless it extends beyond 1945, when it is anticipated that the proposed improvements will be completed. Certainly the pushing of this project cannot be warranted on any basis of sound economics. It would seem to be high time that the taxpayers put a stop to such useless and colossal expenditures that are not required for national defense and threaten to drag us into bankruptcy.

Transportation Board

The Transportation Act of 1940, which was signed by President Roosevelt on September 18, last, provided for the appointment of a board whose duty is "to investigate the relative economy and fitness of carriers by railroad, motor carriers, and water carriers for transportation service, or any particular classes or descriptions thereof, with the view of determining the service for which each type of carrier is especially fitted or unfitted." It also indicated that a study should be made of the methods by which each type of transportation can and should be developed to provide an adequate national transportation system. The board was instructed to transmit preliminary reports of its studies and investigations to the President and to Congress on or before May 1, 1941.

The President finally got around to appointing the board and on March 20 named Wayne Coy, Charles West and Nelson Lee Smith. Coy is an assistant administrator of the Federal Security Agency under Paul V. McNutt, and is regarded as one of his cronies. West was a teacher of political economy for many years and more recently has been an under-secretary in the Department of the Interior. He is more popularly known as the person who has been acting as a liaison between the White House and Congress. Smith is designated as an independent in politics. He also got his start as a teacher of economics in several of our colleges, and since 1934 has been a member and chairman of the New Hampshire Public Service Commission. He, at least, has had some practical experience in the field of transportation as a public servant.

Among the Clubs and Associations

Fuel and Traveling Engineers Program Well Along

Most of the items for the program of the annual meeting of the Railway Fuel and Traveling Engineers' Association, to be held at the Hotel Sherman, Chicago, Tuesday and Wednesday, September 23 and 24, have been definitely settled. The items now established include the following:

Fuel Economy from the Viewpoint of the Water Engineer, by R. C. Bardwell, superintendent water supply, C. & O.

Locomotive Performance as Affected by Steam Distribution (Valve Setting), J. L. Ryan (chairman), mechanical engineer, St. L.-S. F.

Safety and Its Relation to Fuel Conservation.

Address by L. Richardson, mechanical assistant to vice-president and general manager, B. & M.

New Locomotive Economy Devices, A. G. Hoppe (chairman), assistant mechanical engineer, C. M. St. P. & P.

Utilization of Motive Power, A. A. Raymond (chairman), superintendent fuel and locomotive performance, N. Y. C.

Plugged Netting—Causes and Cures, H. Malette (chairman), road foreman of equipment, St. L.-S. F.

Turbine and Condensing Locomotives, L. P. Michael (chairman), chief mechanical engineer, C. & N. W.

The Road Foreman and the Diesel Locomotive, W. D. Quarles (chairman), general mechanical instructor, A. C. L.

Lubrication of Locomotives, W. R. Sugg (chairman), superintendent fuel conservation and lubrication, Mo. Pac.

Air Brakes, J. A. Burke (chairman), supervisor air brakes, A. T. & S. F.

Fuel Records and Statistics, E. E. Ramey (chairman), fuel engineer, B. & O.

Coal—Utilization of the various sizes, S. A. Dickson (chairman), supervisor fuel, Alton.

Car Department Officers at Work on Fall Meeting Program

E. B. Hall, chief mechanical officer, C. & N. W., and D. S. Ellis, chief mechanical officer, C. & O., are expected to address those in attendance at the meeting of the Car Department Officers' Association to be held at the Hotel Sherman, Chicago, Tuesday and Wednesday, September 23 and 24. Reports are under preparation by the following committees:

Maintenance of High-Speed Passenger Brakes, I. E. Keegan (chairman), chief car inspector, Pennsylvania.

Car Shop Operation, Facilities and Tools, A. Herbster (chairman), foreman car department, N. Y. C.

Passenger - Train - Car Terminal Handling — Water-Cooled Air-Conditioning Condensers, R. K. Betts (chairman), foreman car repairs, Pennsylvania.

Lubricants and Lubrication—Journal-Box Packing, J. R. Brooks (chairman), supervisor lubrication and supplies, C. & O.

Uniform Commodity Requirements and Commodity Cards, H. E. Wagner (chairman), general car foreman, Mo. Pac.

Interchange and Billing for Car Repairs, F. G. Bishop (chairman), general foreman car department, Illinois Central.

A. A. R. Loading Rules, H. T. DeVore (chairman), chief interchange inspector, Youngstown Car Inspection Association.

Painting, E. W. Grimminger, foreman painter, car department, Pennsylvania.

Locomotive Maintenance Officers' Annual Meeting Program

Reports on several subjects have been definitely assigned to the program of the Locomotive Maintenance Officers' Association for its annual meeting to be held at the Hotel Sherman, Chicago, on September 23 and 24, and the preparation of reports on the following subjects are now under way:

Maintenance of Air-Brake Equipment, J. P. Stewart (chairman), general supervisor air brakes, Mo. Pac.

Apprenticeship, Roy V. Wright (chairman), editor, *Railway Mechanical Engineer.*

Improved Locomotive Repair Practices, N. M. Trapnell (chairman), assistant superintendent motive power, C. & O.

Lubrication, J. R. Brooks (chairman), supervisor lubrication and supplies, C. & O.

It is also planned to have reports on the Care and Maintenance of Shop Tools and Safety.

Five Subjects on Boiler Makers' Annual Meeting Program

Committees have been chosen and are already at work on five subjects for presentation at the two-day meeting of the Master Boiler Makers' Association to be held September 23 and 24 at the Hotel Sherman, Chicago. The subjects are as follows:

Topic No. 1—Shop Kinks and New Ways of Doing Things in the Boiler Shop, S. Christopherson (chairman), supervisor of boiler inspection and maintenance, N. Y. N. H. & H.

Topic No. 2—Application and Maintenance of Flues, Tubes, and Arch Tubes, Frank A. Longo (chairman), general boiler foreman, Southern Pacific.

Topic No. 3—Treating Feedwater Chemically, Carl A. Harper (chairman), general boiler inspector, C. C. C. & St. L.

Topic No. 4—Application and Service of Straight vs. Tapered Radial Staybolts (including iron, steel and alloy material), R. W. Barrett (chairman), chief boiler inspector, Canadian National.

Topic No. 5—Application of Iron Steel and Alloy Rivets, A. G. Trumbull (chairman), chief mechanical engineer, Advisory Mechanical Committee, C. & O.

DIRECTORY

The following list gives names of secretaries, dates of next regular meetings, and places of meetings of mechanical associations and railroad clubs:

Allied Railway Supply Association.—J. F. Gettrust, P. O. Box 5522, Chicago.

American Society of Mechanical Engineers.—C. E. Davies, 29 West Thirty-ninth street, New York.

Railroad Division.—C. L. Combes, *Railway Mechanical Engineer,* 30 Church street, New York City.

Machine Shop Practice Division.—Warner Seely, Warner & Swasey Co., 5701 Carnegie avenue, Cleveland, Ohio.

Materials Handling Division. — F. J. Shepard, Jr., Lewis-Shepard Co., Watertown Station, Boston, Mass.

Oil and Gas Power Division.—L. N. Rawley, Jr., Power, 330 West Forty-second street, New York.

Fuels Division.—D. C. Weeks, Consolidated Edison Co., 4 Irving Place, New York.

Anthracite Valley Car Foremen's Assn.—Exec. sec., Walter B. Riggin, 215 Swartz street, Dunmore, Pa. Meets third Monday of each month at Wilkes-Barre, Pa.

Association of American Railroads.—Charles H. Buford, vice-president Operations and Maintenance Department, Transportation Building, Washington, D. C.

Operating Section.—J. C. Caviston, 30 Vesey street, New York.

Mechanical Division.—A. C. Browning, 59 East Van Buren street, Chicago. Meeting at Hotel Jefferson, St. Louis, Mo., June 19 and 20.

Purchases and Stores Division.—W. J. Farrell, 30 Vesey street, New York.

Motor Transport Division.—George M. Campbell, Transportation Building, Washington, D. C.

Canadian Railway Club.—C. R. Crook, 4415 Marcil avenue, N. D. G., Montreal, Que. Regular meetings, second Monday of each month, except June, July and August, at Windsor Hotel, Montreal, Que.

Car Department Association of St. Louis.—J. J. Sheehan, 1101 Missouri Pacific Bldg., St. Louis, Mo. Regular monthly meetings third Tuesday of each month, except June, July and August, DeSoto Hotel, St. Louis.

Car Department Officers' Association.—Frank Kartheiser, chief clerk, Mechanical Dept., C. B. & Q., Chicago. Annual meeting, Hotel Sherman, Chicago, September 23 and 24.

Car Foremen's Association of Chicago.—G. K. Oliver, 8238 S. Campbell avenue, Chicago. Regular meetings, second Monday in each month, except June, July and August, La Salle Hotel, Chicago.

Car Foremen's Association of Omaha, Council Bluffs and South Omaha Interchange.—H. E. Moran, Chicago Great Western, Council Bluffs, Ia. Regular meetings, second Thursday of each month.

Central Railway Club of Buffalo.—Mrs. M. D. Reed, Room 1817, Hotel Statler, Buffalo, N. Y. Regular meetings, second Thursday of each month, except June, July and August, at Hotel Statler, Buffalo.

Eastern Car Foremen's Association.—W. P. Dizard, 30 Church street, New York. Regular meetings, second Friday of January, February, March, April and October at Engineering Societies Bldg., 29 West Thirty-ninth street, New York.

Indianapolis Car Inspection Association.—R. A. Singleton, 822 Big Four Building, Indianapolis, Ind. Regular meetings, first Monday of each month, except July, August and September, in Indianapolis Union Station, Indianapolis, at 7 p. m.

Locomotive Maintenance Officers' Association.—J. E. Goodwin, general foreman, locomotive department Missouri Pacific, North Little Rock, Ark. Meeting September 23 and 24, Hotel Sherman, Chicago.

Master Boiler Makers' Association.—A. F. Stiglmeier, secretary, 29 Parkwood street, Albany, N. Y. Annual meeting, Hotel Sherman, Chicago, September 23 and 24.

Mid-West Air Brake Club.—C. R. Ehni (secretary-treasurer), mechanical inspector, St. Louis-San Francisco, Springfield, Mo.

New England Railroad Club.—W. E. Cade, Jr., 683 Atlantic avenue, Boston, Mass. Regular meetings, second Tuesday in each month, except June, July, August and September.

New York Railroad Club.—D. W. Pye, Room 527, 30 Church street, New York. Meetings, third Thursday in each month, except June, July, August, September and December at 29 West Thirty-ninth street, New York.

Northwest Car Men's Association. — E. N. Myers, chief interchange inspector, Minnesota Transfer Railway, St. Paul, Minn. Meetings, first Monday each month, except June, July and August, at Midway Club rooms, 1931 University avenue, St. Paul.

Northwest Locomotive Association.—G. T. Gardell, 820 Northern Pacific Building, St. Paul, Minn. Meetings last Monday of each month, except June, July and August.

Pacific Railway Club.—William S. Wollner, P. O. Box 3275, San Francisco, Cal. Monthly meetings alternately in northern and southern California.

Railway Club of Pittsburgh.—J. D. Conway, 1647 Oliver Building, Pittsburgh, Pa. Regular meetings, fourth Thursday in month, except June, July and August, Fort Pitt Hotel, Pittsburgh, Pa.

Railway Fuel and Traveling Engineers' Association.—T. Duff Smith, Room 811, Utilities Building, 327 South La Salle street, Chicago. Annual meeting Hotel Sherman, Chicago, September 23 and 24, 1941.

Railway Supply Manufacturers' Association.—J. D. Conway, 1941 Oliver Building, Pittsburgh, Pa.

Southern and Southwestern Railway Club.—A. T. Miller, P. O. Box 1205, Atlanta, Ga. Regular meetings, third Thursday in January, March, May, July and September. Annual meeting, third Thursday in November, Ansley Hotel, Atlanta, Ga.

Toronto Railway Club.—D. M. George, Box 8, Terminal A, Toronto, Ont. Meetings, fourth Monday of each month, except June, July and August, at Royal York Hotel, Toronto.

Western Railway Club.—W. L. Fox, executive secretary, Room 822, 310 South Michigan avenue, Chicago. Regular meetings, third Monday in each month, except June, July, August and September.

One of two 6,000-hp. Diesel-electric locomotives for use on the new City of Los Angeles and City of San Francisco streamliners

NEWS

B. & O. Mechanics on Six Day Week

THE Baltimore & Ohio has placed all mechanics on its system on a six-day, 48-hour week. The change from the present five-day, 40-hour-week basis, in effect since 1932, affects between 12,000 and 15,000 men. Straight time is paid for six days and time-and-a-half for Sundays and holidays.

U. P. Tests Locomotives for Diesel-Electric Trains

THE first of two Diesel-electric passenger locomotives which will be used on the new City of Los Angeles and City of San Francisco has been delivered by the builder, the Electro-Motive Corporation, and has been under test on the Union Pacific. Each of the locomotives consists of three separate units having two 1,000-hp. engines with a combined rating of 6,000 hp. The overall length of the three units is 209 ft. and the weight 945,000 lb. The wheels of the new locomotives are kept cool during brake applications on long grades by an automatic water spray.

One of the locomotives will be used on the City of Los Angeles of the Union Pacific-Chicago & North Western between Chicago and Los Angeles, Cal., and the other will be used on the City of San Francisco of the Union Pacific-Chicago & North Western-Southern Pacific between Chicago and San Francisco, Cal. Fifteen streamline passenger-train cars will be used on each of these trains, of which 28 will soon be delivered by the Pullman-Standard Car Manufacturing Company.

Lehigh Valley Offers Shop Facilities for Defense Work

PRESIDENT Albert N. Williams of the Lehigh Valley has informed the Office of Production Management of the National Defense Advisory Commission that the road offers the facilities of its Sayre (Pa.) locomotive and car shops to the government for use during hours of the day when they are not in use by the railroad. At present the Lehigh Valley operates one shift of eight hours, and can therefore turn over use of the machinery and buildings to the government for 16 hours out of each 24.

Expediting Rail Movement of Freight Into Army Camps

THE War Department has announced the completion of plans by the Commercial Traffic Branch of the Quartermaster Corps to facilitate the movement into, around, and out of Army posts, camps and stations, the "many thousands of freight cars which will be needed to carry supplies and equipment for an Army of 1,418,000 men."

The steps necessary to accomplish this task, the statement says, involve up-to-the-minute surveys of operations and quick deliveries of locomotives to 56 camps and army posts throughout the country. Cited as examples of the problems to be met are Fort Bragg in North Carolina, where about 5,000 cars will be handled each month; Camp Blanding, Florida, where 50,000 troops will be encamped by June 15, anticipates 20 cars a day, and Camp Wolters, near Mineral Wells, Texas, will have 17,000 feet of railroad track, and 16,000 officers and men to serve by June 15. The last of 60 locomotives of various types and sizes for these army operations will be delivered by September at a cost of $1,400,-000.

To expedite deliveries of locomotives for these operations, E. R. Stettinius, Jr., director of priorities of the Office of Production Management, has announced the inclusion in the government's priorities critical list of Diesel-electric, gasoline, and electric locomotives. Manufacturers receiving orders from either the Army or Navy will thus be required to complete them ahead of non-priority orders. The

(Continued on next left-hand page)

Orders and Inquiries for New Equipment Placed Since the Closing of the March Issue

LOCOMOTIVE ORDERS

Road	No. of Locos.	Type of Locos.	Builder
American Brass Co.	1[1]	45-ton fireless loco.	Heisler Loco. Wks.
Atchison, Topeka & Santa Fe	2	5,400-hp. Diesel-elec., frt.	Electro-Motive Corp.
	1	2,000-hp. Diesel-elec., pass	Electro-Motive Corp.
Boston & Maine	3	380-hp. Diesel-elec.	General Electric Co.
Canadian National[2]	25	4-8-4	American Loco. Co.
Chicago & North Western	4	2,000-hp. Diesel-elec.	Electro-Motive Corp.
	1	2,000-hp. Diesel-elec.	American Loco. Co.
Chicago, Rock Island & Pacific	5	44-ton Diesel-elec.	Davenport-Besler Corp.
Cincinnati, New Orleans & Texas Pacific	2	5,400-hp. Diesel-elec. frt.	Electro-Motive Corp.
Connecticut Light & Power Co.	1	45-ton fireless loco.	Heisler Loco. Wks.
E. I. du Pont de Nemours Co.	2	400-hp. Diesel-elec.	Vulcan Iron Wks.
Lone Star Cement Corp.	2	180-hp. Diesel-mech.	Vulcan Iron Wks.
Missouri Pacific	2[4]	4,000-hp. Diesel-elec.	Electro-Motive Corp.
New York, New Haven & Hartford	10	660-hp. Diesel-elec.	American Loco. Co.
New York Shipbuilding Co.	1	0-4-0	Vulcan Iron Wks.
Norton Company	1[1]	85-ton fireless loco.	Heisler Loco. Wks.
Panama Railroad	3	Oil-burning steam	H. K. Porter Co.
St. Paul Union Depot	1	380-hp. Diesel-elec.	General Electric Co.
Southern Pacific	40[5]	Cab ahead	Baldwin Loco. Wks.
	10[5]	Daylight	Lima Loco. Wks.
	10[6]	Diesel-elec.	American Loco. Co.
	10[6]	Diesel-elec.	Electro-Motive Corp.
	5[6]	Diesel-elec.	Baldwin Loco. Wks.
U. S. Navy Dept.	6	300-hp. Diesel-elec.	General Electric Co.
	4	180-hp. Diesel-mech.	Vulcan Iron Works
	6	300-hp. Diesel-elec.	Vulcan Iron Works
U. S. War Dept.	5	35-ton Diesel-elec.	Davenport-Besler Corp.
	2	30-ton Diesel-mech.	Davenport-Besler Corp.
	15	20-ton gas.-mech.	Davenport-Besler Corp.
	4	300-hp. Diesel-elec.	General Electric Co.[3]
	3	400-hp. Diesel-elec.	General Electric Co.[3]

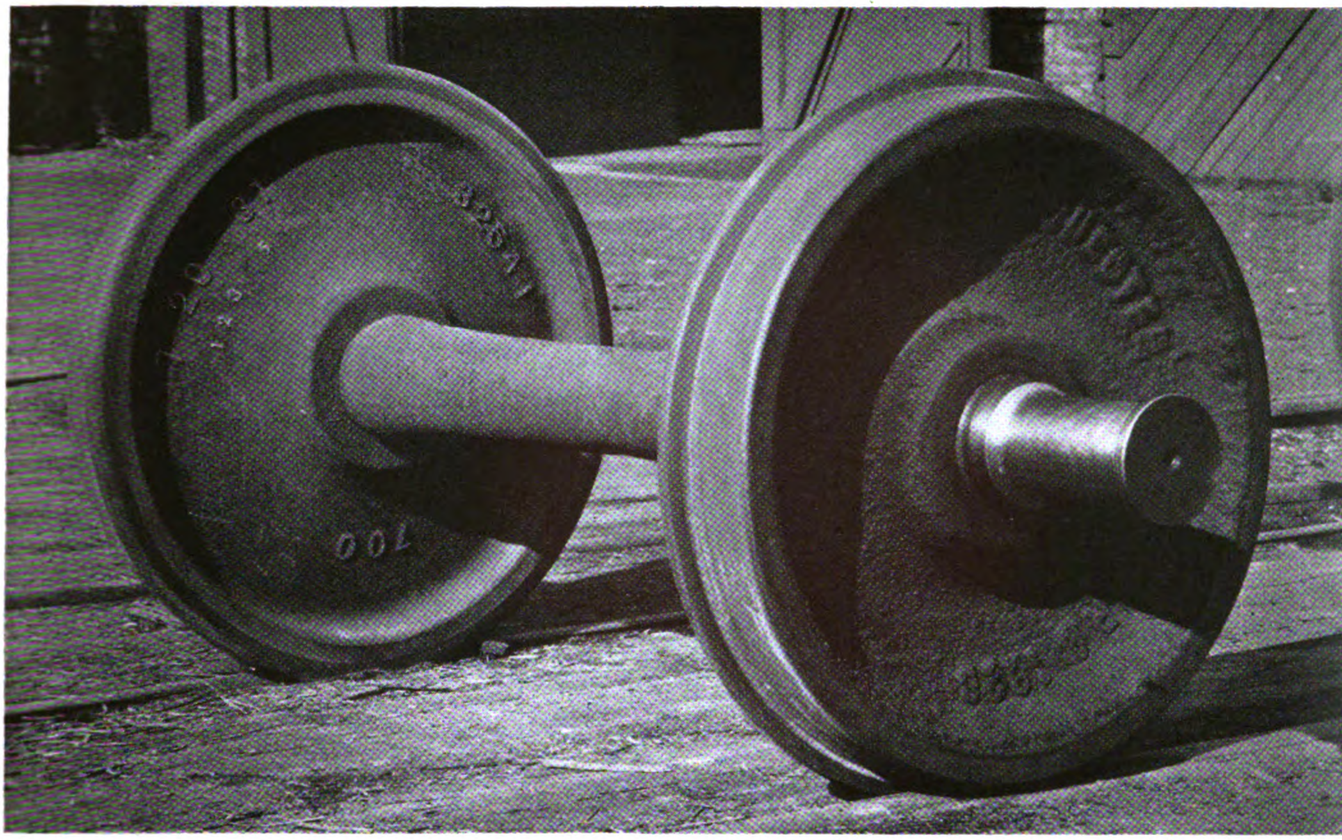


PHOTO BY LYNCH—CHICAGO

Orders and Inquiries for New Equipment—Continued

Road	No. of Cars	Type of car	Builder
		FREIGHT-CAR ORDERS	
American Refrig. Transit Co.	150	40-ton refrigerator	Company shops
Baltimore & Ohio	500	70-ton gondolas	American Car & Fdry. Co.
	500	70-ton gondolas	Bethlehem Steel Co.
	1,000	50-ton hopper	Gen. Amer. Trans. Corp.
	250	50-ton box	Pull.-Std. Car Mfg. Co.
	100	70-ton cement	Greenville Steel Car Co.
Bethlehem Steel Co.	14	100-ton flat	Company shops
Canadian National	250	70-ton hopper	Eastern Car Co.
	150	50-ton ballast	National Steel Car Corp.
	125	80-ton ore	
	200	Flat	Canadian Car & Fdry. Co.
	100	40-ton refrigerator	Company shops
Central of New Jersey	1,000	50-ton hopper	[8] Company shops
	50	Cement	
	50	Caboose	
Chesapeake & Ohio	25	70-ton flat	Ralston Steel Car Co.
	10	125-ton flat	Greenville Steel Car Co.
	10	125-ton well	
Chicago, St. Paul, Minneapolis & Omaha	700	50-ton box	American Car & Fdry. Co.
Denver & Rio Grande Western	10	Cabooses	Bethlehem Steel Co.
Lake Superior & Ishpeming	100[7]	50-ton ore	Bethlehem Steel Co.
Lehigh & New England	100[11]	70-ton hopper bottom	American Car & Fdry. Co.
Minneapolis, St. Paul & Sault Ste. Marie	100	50-ton flat	Pull.-Std. Car Mfg. Co.
	50	50-ton ballast	American Car & Fdry. Co.
New York, New Haven & Hartford	1,000[9]	Box	Pressed Steel Car Co.
Pere Marquette	100	50-ton box	Pull.-Std. Car Mfg. Co.
	100	50-ton box	American Car & Fdry. Co.
	100	50-ton box	Gen. Amer. Trans. Corp.
	100	50-ton box	Greenville Steel Car Co.
	100	40-ton automobile	Ralston Steel Car Co.
Phelps Dodge Corp.	80	90-ton air dump	Differential Steel Car Co.
John Roebling's Sons Co.	10	70-ton gondolas	American Car & Fdry. Co.
Southern Pacific	500[6]	50-ton box	Pressed Steel Car Co.
	500[6]	50-ton box	Gen. Amer. Trans. Corp.
	500[6]	50-ton box	Bethlehem Steel Co.
	500[6]	50-ton box	Pull.-Std. Car Mfg. Co.
	500[6]	50-ton box	Mt. Vernon Car Mfg. Co.
Tennessee Coal, Iron & R. R. Co.	90	70-ton ore	Pull.-Std. Car Mfg. Co.
	85	70-ton hopper	
Utah Copper Co.	75	Ore	Pressed Steel Car Co.
Wabash[10]	150	Automobile	Company shops
	50	Mill-type gondolas	
	15	Caboose	
Western Maryland	40	70-ton covered hopper	American Car & Fdry. Co.
		FREIGHT-CAR INQUIRIES	
Baltimore & Ohio	100	Caboose	....
Canadian Pacific	250	50-ton hopper	....
Chicago, Rock Island & Pacific	25	70-ton hopper-bottom gondolas	....
U. S. Navy Dept., Bureau of Supplies and Accounts	6	70-ton flat	....
		PASSENGER-CAR ORDERS	
Chicago & North Western	3	Bagg.-taproom-lounge	Pull.-Std. Car Mfg. Co.
	14[13]	Coaches	
	4[13]	Diners	
	4[13]	Parlor	
Chesapeake & Ohio	20	Coaches	American Car & Fdry. Co.
Missouri Pacific	2	Diner-lounge	[4] Edw. G. Budd
	4	Coaches	
	2	Mail	
	2	Mail-bagg.	
	1	Reserve mail-bagg.	
	4	Spec. designed Pullman	Pull.-Std. Car Mfg. Co.
Norfolk & Western	15	Coaches	Pull.-Std. Car Mfg. Co.
Union Pacific	30	Chair	[12] Pull.-Std. Car Mfg. Co.
	30	Baggage	
	10	Bagg.-mail	

[1] Delivery received.
[2] For use of Grand Trunk Western Lines.
[3] U. S. War Dept. orders placed with General Electric so far this year includes four 45-ton Diesel-electric locomotives of 300 hp. and three 60-ton Diesel-electric locomotives of 400 hp.
[4] For two streamline trains for service between St. Louis, Mo., and Denver, Colo.
[5] Estimated cost of cab ahead and Daylight locomotives $11,000,000.
[6] In addition to the orders for 15 Diesel-electrics reported in the March issue. The total cost of the 40 Diesel-electric locomotives is estimated at $2,900,000. The 2,500 freight cars will cost approximately $9,000,000.
[7] Order not confirmed.
[8] Contracts authorized by court authority. Cost of equipment estimated at $2,670,587.
[9] Purchase authorized by court. Builder expected to be Pressed Steel Car Co.
[10] Asking for prices on parts to build this equipment.
[11] For bulk cement.
[12] Lightweight construction.
[13] Two coaches, a diner, and a parlor car for use on the Minnesota "400".

priorities critical list includes all fabricated parts necessary for the completion, maintenance or operation thereof, which are designed to meet military specifications and, as designed, are not commercially useful for ordinary civilian purposes.

D. L. & W. Releasing Mechanics for Defense

THE Delaware, Lackawanna & Western is planning to work its shops full time as nearly as business will permit, according to President William White. About 200 employees of its mechanical department will thereby be released for work in defense industries; their railroad seniority rights will be preserved in the interim in accordance with their working agreement. The move is being made in accordance with a program of the National Defense Railway Industry Committee, consisting of management and labor representatives, which contemplates that railroads will determine shop programs for 1941, and on that basis arrange to work their forces as nearly full time as practicable so that men of the mechanical crafts not necessary for railroad work may be released to the defense industry and to other railroads.

Priorities for Machine Tools

ACTING by virtue of authority granted the Executive in the National Selective Service Act of last year, E. R. Stettinius, Jr., director of priorities of the Office of Production Management, issued an order on February 24 which places aluminum producers and machine-tool builders under a mandatory priority status. The order, which expires on May 31, 1941, was put into effect to speed up the defense program and hasten the delivery of machine tools. It directs machine-tool makers to "serve all such defense orders in preference to any non-defense orders, in so far as this course is necessary to comply with the delivery dates on such defense orders."

1940 Operating Efficiency Record

NEW high records in operating efficiency were attained by the railroads in 1940, according to complete reports received for that year, J. J. Pelley, President of the Association of American Railroads, announced on March 11.

"The outstanding feature in railroad performance," Mr. Pelley said, "was the increase in the amount of freight that was carried per train, that average in 1940 having been 849 tons compared with 813 tons in 1939, and 804 tons in 1929, the year of heaviest traffic in the history of the railroads. Freight-train performance in 1940 was approximately twice that of 20 years ago. That is, gross ton-miles per train hour increased from 16,555 in 1921 to 33,808 in 1940, or 104 per cent, while net ton-miles per freight train hour increased from 7,506 in 1921 to 14,027 in 1940, or 87 per cent. These are new high records in both instances.

"Freight locomotives in 1940 operated a daily average of 107.2 miles, which also was a new high record. The average daily movement of all freight cars, which includes those being loaded and unloaded, was 38.7 miles in 1940 which also was a new high record. Net ton-miles per freight car per day was 661 ton-miles, also a new record. The previous record was established in 1937 with an average of 625 ton-miles per day.

"Fuel efficiency in freight service was never better than in 1940. Despite the increased weight per train and the increase that has taken place in recent years in the average speed of trains, the railroads in 1940 averaged 112 lbs. of fuel for the movement one mile of 1,000 tons of freight and equipment. This average has never before been attained. For each pound of fuel used in freight srvice in 1940, the railroads hauled 8⁹⁄₁₀ tons of freight and equipment one mile compared with 6⅛ tons in 1921, or an increase of 44 per cent.

"Railroads in 1940 had an average of

(*Continued on next left-hand page*)

144,249 unserviceable freight cars, the lowest number in need of repair on record. This was 7.9 per cent of ownership. Since then, this number has been further reduced with the result that on February 1 this year there were only 107,596 unserviceable cars, or 6.7 per cent of ownership.

". . . Taken as a whole, the year's performance was the best in railroad history."

L. B. Sherman, Senior Vice President of Simmons-Boardman Retires

LUCIUS (LOU) BOOTH SHERMAN, senior vice-president of the Simmons-Boardman Publishing Corporation, with headquarters at Chicago, has retired on pension after more than 50 years' association with the railroads and the railway supply industry.

Lucius Booth Sherman

During his career, Mr. Sherman has taken an active part in the Railway Manufacturers Supply Association and the National Railway Appliances Association, serving as a member of the executive committee of the former and a director of the latter for a number of years. In 1925 he was one of the American Railway Association's delegates to the International Railway Congress at London, England.

Mr. Sherman was born in Chicago on April 18, 1863, and after attending the University of Chicago, he immediately chose the selling phase of the publishing business for his career. In 1884 he entered the employ of the Railway Review and soon after rose to business manager of that publication. Later he resigned to become associated with the Railroad Gazette and on November 1, 1901, was promoted to western manager of that publication. In 1908 the Railway Age and the Railroad Gazette were merged into the Railroad Age Gazette and Mr. Sherman was elected vice-president of the new company on May 9, 1911. He continued as vice-president of the Simmons-Boardman Publishing Company, which was formed in 1912 to publish the Railway Age and several other railway publications, and later was made senior vice-president. In 1930 when the Simmons-Boardman Publishing Corporation was organized to take over the Railway Review, the Railway Age and other railway magazines and several papers in the building field, Mr. Sherman was elected senior vice-president of the new company.

Equipment Purchasing and Modernization Programs

Atchison, Topeka & Santa Fe.—The Santa Fe has awarded a contract to George Senne & Co., Topeka, Kan., for the construction of a car repair shed at West Wichita, Kan. The building will be 44 ft. wide by 450 ft. long and will have a structural steel frame, corrugated iron sides, and a wooden sheathing and composition roof. It will span two tracks and will be used for repairing freight cars. The total cost of the project will be approximately $120,000.

Baltimore & Ohio.—The board of directors of the B. & O. has approved the purchase of 2,400 freight cars, at an estimated cost of $7,500,000, and four Diesel-electric passenger locomotives of 4,000-hp. each, at an estimated cost of $1,400,000. The 2,400 freight cars comprise the following: 1,000 70-ton gondola cars, 1,000 50-ton hopper cars, 250 50-ton box cars, 150 70-ton cement cars. Orders for a total of 1,350 freight cars are reported elsewhere in this issue.

Canadian Pacific.—The Canadian Pacific is reported to be contemplating the purchase of twenty-five 4-6-2 type locomotives and an undetermined number, reported as twenty-five, 4-8-4 type locomotives.

Chicago, Indianapolis & Louisville.—The C. I. & L. is reported to be inquiring for nine baggage cars and one mail-baggage car.

Chicago, Milwaukee, St. Paul & Pacific.—The C. M. St. P. & P. has petitioned the district court for permission to purchase 16 Diesel-electric locomotives and to spend $7,306,290 for improvements and equipment purchases during 1941. The Diesel-electric locomotives include the following: two 1,000 hp., one 600 hp., ten 360 hp.,—for switching and light road service; two 4,000 hp.—for use on the "Hiawatha"; one 5,400 hp.—for main line freight service.

Among the improvements considered is the enlargement of enginehouses at Tacoma, Wash., and Madison, Wis. For new freight and passenger cars to be built in company shops, a total of $2,387,500 will be spent. Orders have been placed with company shops for the construction of 500, 50-ton wood-lined steel box cars, 25 caboose cars, six 100-ton flat cars, of which four will have depressed floors and two will have depressed floors and wells, and 20 passenger cars.

In addition to the $7,306,290 program, the Milwaukee is also contemplating the purchase of at least one Diesel-electric mainline freight locomotive for use in Idaho and Washington, and the expenditure of $2,500,000 for the modernization of locomotives and locomotive servicing facilities.

Detroit, Toledo & Ironton.—The D. T. & I. has asked the Interstate Commerce Commission for authority to assume liability for $1,150,000 of equipment trust certificates, maturing in equal annual installments of $115,000 on March 1, in each of the years from 1942 to 1951, inclusive. The proceeds will be used as part payment for new equipment costing a total of $1,474,000 and consisting of 300 gondola cars, four steam locomotives, and two Diesel-electric locomotives.

Illinois Central—The Illinois Central is reported to be in the market for one two-car passenger train.

Kansas City Southern.—The Kansas City Southern is reported to be in the market for one or two rail motor cars.

Lehigh Valley.—The Lehigh Valley is reported to be contemplating the acquisition of some small Diesel-electric switching locomotives.

New York, Ontario & Western.—The N. Y. O. & W. is reported to be contemplating the acquisition of four small Diesel-electric switching locomotives.

Norfolk & Western.—The N. & W. is reported to be contemplating building five or six mallet type locomotives in the company's own shops.

Supply Trade Notes

THE ARDCO MANUFACTURING COMPANY has moved from its plant in Jersey City, N. J., into larger quarters at 1116 Paterson Plank Road, North Bergen, N. J.

◆

ROBERT WATSON, formerly western sales manager, locomotive equipment division, of Manning, Maxwell & Moore, has been appointed western sales manager of the Waugh Equipment Company with offices in Chicago. Mr. Watson was associated with the American Locomotive Company from 1923 to 1926, at which time he joined the mechanical department of the Erie. In 1929 he was appointed mechanical engineer of the Firebar Corporation and continued in that capacity for six years after the merger of the Firebar Corporation with the Waugh Equipment Company in 1932.

◆

F. H. LINDUS, branch manager in charge of the service-sales division of the Timken Roller Bearing Company, with headquarters at Los Angeles, Calif., has been transferred to Canton, Ohio, where he is engaged in general sales promotional work.

◆

NEWTON P. SELOVER has been appointed western sales manager of the locomotive equipment division of Manning, Maxwell & Moore, Inc., with headquarters at Chicago. For the past seven years Mr. Selover has represented the locomotive equipment division on the Pacific coast, with headquarters in San Francisco, Calif.

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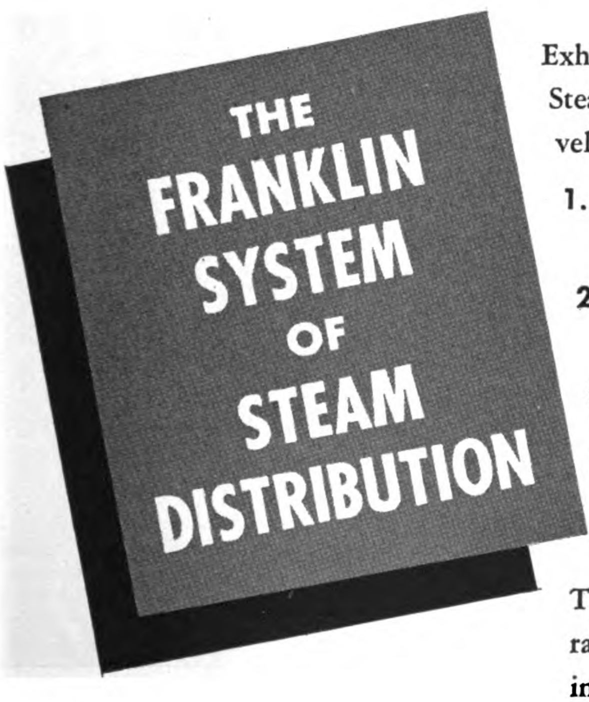
Mean Effective Pressure
determines
Locomotive Performance

In a paper issued by the Office of Mechanical Engineer of the A. A. R. in February, 1939, covering A. A. R. Passenger Locomotive Tests in October, 1938, the following statement appears:

"... Nothing developed in the tests to indicate that any of the locomotives had reached the limit of boiler capacity. Therefore, the question of sustained power at high speeds becomes a question of mean effective pressure in the cylinders..."



Exhaustive tests have demonstrated that the Franklin System of Steam Distribution makes it possible for a locomotive to develop the maximum mean effective pressure. It provides:

1. Separation of valve events, so that admission, cut-off, release and compression are independently controlled.
2. Larger inlet and exhaust passages and improved steam flow.
3. Reduced cylinder clearance volume.
4. Increased mechanical efficiency, obtained by reduced weight of moving masses, reduced friction and elimination of carbonization.

The Franklin System of Steam Distribution is offered to the railroads of the United States to meet the objective outlined in the A. A. R. report.

FRANKLIN RAILWAY SUPPLY COMPANY, INC. NEW YORK CHICAGO MONTREAL

Marion Law, Jr. has been appointed public relations director for the Edward G. Budd Manufacturing Company, succeed-

Marion Law, Jr.

ing W. Howe Sadler who has resigned. Mr. Law has been with the Budd Company for two years as a publicity representative. Prior thereto he was in charge of the New York office of the T. W. A. News Bureau.

◆

Clarence C. Rausch, who has been affiliated with the Dearborn Chemical Company, Chicago, for 20 years, has been appointed assistant vice-president in charge of NO-OX-ID sales to railways, with

Clarence C. Rausch

headquarters at Chicago. During the last 10 years, Mr. Rausch has devoted his time to the promotion of NO-OX-ID rust preventive in the railway industry. Prior to his service with the Dearborn Chemical Company, he spent four years in the operating department of the Pennsylvania.

◆

Grip Nut Company.—*E. H. Weigman*, who was appointed sales manager for the Grip Nut Company on January 1, 1941, has now been elected vice-president in charge of sales with headquarters in Chicago. *John D. Ristine* has been appointed assistant to the president, with headquarters at Chicago, and *Erastus Emery*, eastern district sales manager, with headquarters at Pittsburgh, Pa. A sketch and photograph of Mr. Weigman appeared in the February issue, page 86.

American Locomotive Company.—*J. G. Blunt*, formerly chief mechanical engineer, has been appointed assistant to the vice-president in charge of engineering of the American Locomotive Company. Sherman Miller, superintendent of the general drawing room at Schenectady, succeeds Mr. Blunt as mechanical engineer.

J. G. Blunt was graduated with a degree in mechanical engineering from the University of Michigan in 1894. During his early business career he was employed as a machinist at the Buda Company, Harvey, Ill.; draftsman at the Welland Iron Works, Welland, Ont., and draftsman at the Bucyrus Company and the Industrial Works, Bay City, Mich. In 1897 he took a position as draftsman with the Brooks Locomotive Works at Dunkirk, N. Y., becoming chief draftsman in 1899. In 1906,

James G. Blunt

following the formation of the American Locomotive Company, of which the Brooks Locomotive Works became a part, he was transferred to Schenectady, N. Y., and appointed engineer of the drafting department. In 1916 Mr. Blunt became mechanical engineer and in 1936 chief mechanical engineer. In 1923 he was vice-chairman of the A. S. M. E., Schenectady division.

Sherman Miller after leaving high school became employed in the erecting shop of the Brooks Locomotive Works and four

Sherman Miller

years later was transferred to the drawing room. After attending Purdue University (class of 1905, mechanical engineering) Mr. Miller returned to the Brooks Locomotive Works and in 1907 was appointed assistant chief draftsman. In July of that year he was transferred to Schenectady, N. Y., where the general drawing room of the American Locomotive Company was being organized, and in 1916 became superintendent of the general drawing room.

◆

American Brake Shoe & Foundry Co. —*A. H. Elliot*, vice president of the Southern Wheel Division of the American Brake Shoe & Foundry Company, has been placed in charge of development, engineering and service. Mr. Elliot graduated from the Sheffield Scientific School in 1904 and was with the Pennsylvania until 1909, at which time he joined the American Brake Shoe & Foundry Co. He was elected vice-president of the Southern Wheel division in 1927. *J. T. Talbot* has been elected vice-president in charge of sales. He has been associated with the company since 1920 and is also vice-president of the Brake Shoe & Castings division. *W. C. Appleby* has been appointed operating manager. Mr. Appleby started with the Decatur Car Wheel Company in 1906, shortly after graduating from Georgia Tech and became a member of the Southern wheel organization when the Decatur Company was taken over. *J. B. Spencer* has resigned as vice-president of the Southern Wheel division to devote all his time to the Ramapo Ajax division, of which he is president.

Obituary

William T. Bennison, a railroad contact officer of the Edward G. Budd Manufacturing Company, died March 16 after a protracted illness. He was 50 years of age. Mr. Bennison graduated from Syracuse University in 1913 and entered the

William T. Bennison

employ of the Chicago, Milwaukee, St. Paul & Pacific, where he later became engineer of tests. During his subsequent business career he was assistant mechanical engineer; development and service engineer of the Locomotive Feedwater Heater Company (now the Superheater Company); equipment engineer with the Westinghouse Electric and Manufacturing Company, and assistant chief engineer of the Corning Glass Company. He joined the Budd

(*Continued on next left-hand page*)

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Company in 1933 to help produce the first Diesel-electric stainless steel Zephyr. He was a member of the New York Railroad Club and the Western Railway Club.

◆

HENRY S. MANN, who retired as district sales manager of the Standard Stoker Company, Inc., Chicago, on March 1, 1939, died in that city on March 16 of a heart ailment. Mr. Mann was born in New Hampshire on September 23, 1865, and entered railway service on the Old Colony. Later he was employed on the Wabash, the Illinois Central, and the Northern Pacific, following which he served as service engineer of the Westinghouse Air Brake Company and western manager of the Metal & Thermit Corporation. He resigned from the latter position in 1924 to become district sales manager of the Standard Stoker Company, Inc.

Personal Mention

General

C. O. YOUNG, assistant chief clerk in the car department of the Illinois Central at Chicago, has been promoted to the newly created position of assistant to the superintendent of equipment at Chicago.

L. L. HOEFFEL, master mechanic of the Union Pacific at Los Angeles, Cal., has been appointed superintendent of motive power and machinery of the South-Central and Northwestern districts, with headquarters at Pocatello, Idaho.

P. O. CHRISTY, master mechanic of the Illinois Central at Paducah, Ky., has been promoted to superintendent of equipment, a newly created position with headquarters at Chicago. Mr. Christy was born at Water Valley, Miss., on August 1, 1898, and entered railway service on May 1, 1912, as a call boy in the mechanical department at Water Valley, later serving as a clerk and a machinist apprentice at Water Valley, a timekeeper at Memphis, Tenn., and a machinist apprentice at McComb, Miss. During the first World War he was a machinist mate in the U. S. Navy. He returned to McComb on August 16, 1919, and was promoted to machinist on March 1, 1920, serving successively at Baton Rouge, La., Memphis, and Asylum, Miss. On October 17, 1925, he became enginehouse foreman at Gwin, Miss., being later transferred to Asylum. On October 1, 1930, he was appointed to general foreman and on January 1, 1935, was transferred to Centralia, Ill. Mr. Christy became assistant master mechanic at the Markham yards, Chicago, on May 1, 1937, and master mechanic at Paducah, Ky., on January 16, 1938.

Paul O. Christy

A. F. COULTER, superintendent of rolling stock of the Union Railroad, with headquarters at East Pittsburgh, Pa., retired from active service on February 12, after 45 years of continuous railway service. Mr. Coulter began his career in 1896 as a car repairman at the Glenwood shops of the Baltimore & Ohio and became car inspector in 1898. In 1900 he was appointed chief car inspector and was sent to McKees Rocks, Pa., to supervise the construction of 9,500 all-steel hopper and gondola cars at the plant of the Pressed Steel Car Company. At the completion of this work in 1901, he returned to the Glenwood shops as car foreman. He was appointed general car foreman in 1903, and in 1907, resigned to accept a similar position with the Union Railroad. Mr. Coulter became master car builder of the Union Railroad in 1926 and superintendent of rolling stock in 1936.

STANLEY C. SMITH, superintendent of motive power and machinery of the South-Central and Northwestern districts of the Union Pacific, with headquarters at Pocatello, Idaho, has been appointed acting general superintendent of motive power and machinery, at Omaha, Neb. Mr. Smith was born at New Albany, Ind., on October 1, 1895, and entered railway service in 1911 as a machinist apprentice on the Southern. In 1915, he became a machinist on the Chicago, Rock Island & Pacific, later serving in that capacity on the Evansville & Indianapolis (now part of the Big Four) and the Chicago, Terre Haute & Southeastern (now part of the Chicago, Milwaukee, St. Paul & Pacific). In February, 1920, Mr. Smith went with the Union Pacific as assistant enginehouse foreman at Green River, Wyo. He was transferred to Pocatello as district foreman in 1933, and in 1936 was promoted to master mechanic. In 1939 he became assistant general superintendent of motive power and machinery for the South-Central and the Northwestern districts, with the same headquarters, and later his title was changed to superintendent of motive power and machinery.

JOHN FRANCIS BURNS, works manager of the Angus shops of the Canadian Pacific at Montreal, Que., who has retired because of ill health, as noted in the March issue of the *Railway Mechanical Engineer*, was born on October 14, 1877, at Montreal. He attended the Sansfield School from 1883-1892 and on October 14, 1892, entered the employ of the Grand Trunk, serving five years as an apprentice and one as a fitter. He entered the service of the Canadian Pacific in 1898, as a fitter in the mechanical department, Windsor Station, Montreal. Later, he was leading hand fitter and locomotive foreman at North Bay, Ont., White River, and Chapleau. Mr. Burns became district master mechanic at North Bay, in 1908; and, successively, district master mechanic at London, Ont., and master mechanic, eastern division, with headquarters at Montreal in 1911. In 1918, he was promoted to the position of assistant works manager at the Angus shops and the following year became works manager. The special royal train for the visit of King George VI and Queen Elizabeth in 1939 was fitted under the supervision of Mr. Burns.

J. F. Burns

G. W. BIRK has been appointed assistant to general superintendent of motive power of the New York Central at New York.

JOHN GOGERTY, superintendent of motive power and machinery for the Eastern district of the Union Pacific, has had his headquarters transferred from Omaha, Neb., to Cheyenne, Wyo.

Master Mechanics Road Foremen

J. A. WELSCH, general foreman of the Illinois Central at New Orleans, La., has become master mechanic at Paducah, Ky.

W. F. KASCAL, general foreman on the Chicago, Burlington & Quincy at Lincoln, Neb., has been appointed acting master mechanic of the Lincoln and Wymore divisions, with the same headquarters, succeeding T. E. Paradise, who has been ill for some time.

Paul Thomas, assistant master mechanic of the Philadelphia division of the Pennsylvania, who has been promoted to master mechanic of the Chicago Terminal and Logansport divisions at Chicago, as announced in the February issue, was born on September 30, 1898, at Elkhart, Ind.

Paul Thomas

He was graduated from Elkhart high school in 1918 and from Purdue University in 1923. He entered railway service on June 29, 1923, as a special apprentice on the Pennsylvania at Altoona, Pa., and on June 4, 1926, became motive-power inspector. On February 1, 1929, he was transferred, as motive-power inspector, to Wilmington, Del., and on December 15, 1929, became gang foreman at York, Pa. Mr. Thomas was appointed enginehouse foreman at Wilkes-Barre, Pa., on March 1, 1932; assistant master mechanic, New York division, on April 16, 1937; enginehouse foreman, Williamsport, Pa., on June 15, 1938; assistant master mechanic, Mingo Junction, Ohio, on October 26, 1939; and assistant master mechanic, Enola, Pa., on August 1, 1940. From June to December, 1918, Mr. Thomas was in U. S. N. R. F. service.

Will Anderson Trayler, Jr., acting master mechanic of the Columbus & Greenville, has been appointed master mechanic

W. A. Trayler, Jr.

with headquarters as before at Columbus, Miss. Mr. Trayler was born on September 22, 1910, at El Paso, Tex. He received the degree of B.S. in mechanical engineering (with railway mechanical engineering option) at Purdue University in January, 1936. During the second semester, 1935-36, he was an instructor in machine design and mechanical laboratory at Purdue University. He was mechanical engineer on production at the Barberton works of the Babcock & Wilcox Co., from 1936 to 1938. He entered the service of the Columbus & Greenville on August 1, 1938, and on January 16, 1940, became acting master mechanic of the Columbus & Greenville at Columbus.

J. F. Hunt, foreman, Philadelphia division of the Pennsylvania, has been appointed assistant master mechanic of the Philadelphia division.

A. R. Snyder, acting master mechanic for the Union Pacific at Council Bluffs, Iowa, has been promoted to master mechanic at that point.

Edward Joseph Burck, superintendent of shops of the Michigan Central at Jackson, Mich., has been appointed division master mechanic of the New York Central System with headquarters at St. Thomas, Ont. Mr. Burck was born on January 29, 1883, at Monroe, Mich. He entered rail-

E. J. Burck

way service on August 14, 1901, as a machinist apprentice on the Michigan Central at Jackson. He became a machinist in 1904, and enginehouse foreman in 1909. He was transferred as enginehouse foreman to Kalamazoo, Mich., in 1913, and to Jackson in 1918. In 1926, he was appointed superintendent of shops at Jackson.

William Henry Gimson, general foreman on the St. Louis-San Francisco at Springfield, Mo., who has been promoted to master mechanic of the Southwestern and Western divisions, with headquarters at West Tulsa, Okla., as announced in the February issue, was born on September 13, 1887, at Memphis, Tenn. He entered railway service on September 1, 1904, as toolroom attendant for the St. Louis-San Francisco at Memphis and later became a machinist apprentice. Upon the completion of his apprenticeship, he became a machinist and subsequently was appointed assistant enginehouse foreman. On June 10, 1917, he was promoted to general foreman, at Monett, Mo.; on May 1, 1924, was transferred as general foreman to Memphis, and on August 16, 1929, was appointed superintendent, North shops, Springfield, Mo., and on September 5, 1931, was appointed general foreman of the North shops and enginehouse at Springfield, Mo.

Car Department

John I. Okerberg has been promoted to car foreman of the Atchison, Topeka & Santa Fe at Ottawa, Kan.

C. R. Kerr has been appointed general car foreman of the Union railroad, with headquarters at East Pittsburgh, Pa.

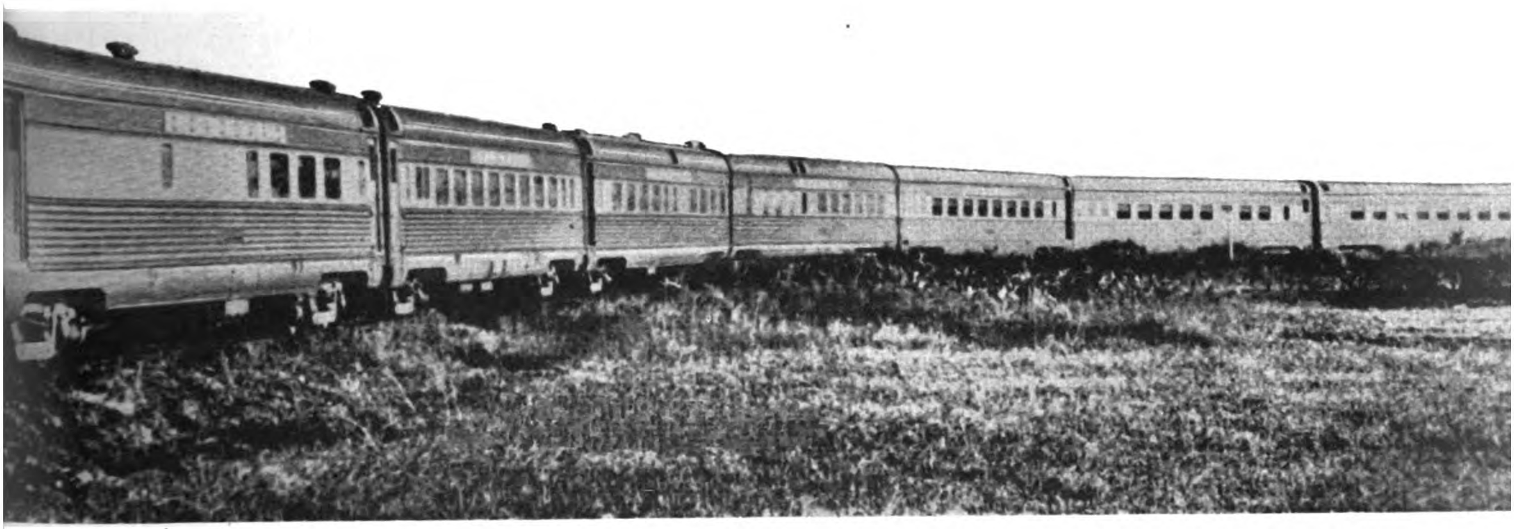
W. B. Weightman, assistant road foreman of engines of the Philadelphia division of the Pennsylvania, has been promoted to general air brake inspector, Central region.

L. R. (Ray) Christy, master car builder of the Gulf Coast Lines and of the International-Great Northern, with headquarters at Houston, Tex., has been

L. R. Christy

appointed superintendent of the car department of the Missouri Pacific Lines, with headquarters at St. Louis, Mo., and the positions of master car builder on the Missouri Pacific, the Gulf Coast Lines, and the International-Great Northern have been abolished. Mr. Christy was born at Water Valley, Miss., on December 19, 1894, and entered railway service on the Illinois Central as a car repairer apprentice at Water Valley. In April, 1912, he was promoted to car repairer, and was later air brake repairer, car inspector, chief clerk and traveling master car builder inspector. On June 9, 1916, he went to Tuscon, Ariz., as M. C. B. clerk on the Southern Pacific and until January 31, 1922, he alternately worked in various capacities in the mechanical department at Tuscon and attended the University of Arizona. Mr. Christy returned to the Illinois Central on February 3, 1922, as an air-brake foreman at Memphis, Tenn., later being appointed rebuilding car foreman. On March 1, 1924, he went with the Missouri Pacific as assistant general car inspector, and a short time later became general car inspector. On February 16, 1926, he was appointed master car builder of the Gulf Coast Lines and the International-Great Northern, with headquarters at Houston.

(Turn to second left-hand page)



ON DECEMBER 15th, 1938, the Seaboard inaugurated its famous "ORANGE BLOSSOM SPECIAL" luxury all-Pullman EMC 6000 hp. Diesel-powered trains to Miami, and followed immediately on February 2nd, 1939, with its also famous "SILVER METEOR" deluxe all-coach streamlined train. Success was immediate. Passenger revenues jumped month after month as a result of these new high standards of travel comfort, "on-time" arrivals, and faster schedules with maximum safety.

The record increase in passenger travel and passenger revenues has required continual expansion of this service so that today a fleet of 20 EMC 2000 hp. Diesel units is handling these modern trains between Washington, Miami, Tampa and St. Petersburg . . . further proof that

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Robert N. Holland, foreman of the freight car department of the Lehigh Valley at Sayre, Pa., has been promoted to general foreman of the passenger and freight car departments at Sayre.

Roland H. Marquart, superintendent of the freight-car department of the Illinois Terminal Railroad, who has been transferred from Decatur, Ill., to St. Louis, Mo., as noted on page 44 of the January issue, was born on May 3, 1888, at Sandusky, Ohio. He attended public school in Sandusky and on April 19, 1905, entered the service of the Baltimore & Ohio at Sandusky. He was consecutively a laborer, car repairman, car inspector and piecework inspector, until May 31, 1911, when he became car foreman at Washington, Ind. On February 20, 1912, he was transferred as car foreman to East St. Louis, Ill. He was appointed general car foreman at Chillicothe, Ohio, on September 1, 1914; general car foreman at Willard, Ohio, on October 1, 1917, and car foreman at Collinsville, Ill., on June 8, 1918. From the latter date until May 1, 1919, Mr. Marquart was in the employ of the Pennsylvania Railroad. He then became assistant chief interchange inspector at St. Louis and East St. Louis Terminals. On October 1, 1930, he returned to the Illinois Terminal as general car foreman at Decatur and on June 1, 1936, was appointed superintendent of the freight-car department.

R. H. Marquart

Charles H. Lundberg, general car foreman of the Ottawa car works of the Atchison, Topeka & Santa Fe at Ottawa, Kan., has retired.

E. H. Waterman, general car foreman of the Union Railroad at East Pittsburgh, Pa., has been promoted to master car builder.

E. O. Rollings at the South Louisville shops (Louisville, Ky.) of the Louisville & Nashville, now functions under the title of superintendent of the South Louisville shops, instead of under the title of master mechanic.

L. E. Hilsabeck, general car inspector of the Chicago Great Western, has been appointed to fill the newly created position of assistant superintendent of the car department, with headquarters as before at Oelwein, Iowa.

F. E. Cheshire, general car inspector, Missouri Pacific, has been promoted to the newly created position of assistant superintendent car department of the same road, effective March 1. Mr. Cheshire is a vice-president of the Car Department Officers' Association.

Shop and Enginehouse

Charles S. Williams, general foreman on the Delaware & Hudson at Colonie, N. Y., has been appointed shop superintendent at Colonie. Mr. Williams was born on March 8, 1881, at Syracuse, N. Y. He received his education through the International Correspondence School and entered railway service as a machinist apprentice on the New York Central on April 1, 1895. He became a machinist on June 1, 1899, and shop piecework inspector, on June 25, 1909, and general piecework inspector motive power department, Lines East, on May 3, 1911. On March 1, 1913, he went to Grand Rapids, Mich., as shop superintendent of the Pere Marquette. On April 1, 1916, he went to Dunkirk, N. Y., as foreman inspector for the New York Central at the plant of the American Locomotive Company. He was assistant master mechanic in the employ of the American Car and Foundry Company at Depew, N. Y., from January, 1918, until May, 1920, and night superintendent of the Buffalo Steel Car Co. at Buffalo, N. Y., from May, 1920, to November, 1922. In November, 1922, he became general piecework supervisor on the Delaware & Hudson at Colonie, and in June, 1923, general foreman at Colonie. He was appointed shop superintendent on October 16, 1940.

Charles S. Williams

T. J. Lyon has been appointed superintendent of shops of the Boston & Albany, at West Springfield, Mass.

William E. Buck, machine foreman on the Michigan Central at Jackson, Mich., has become superintendent of shops at that point.

R. W. Barrett, general boiler foreman of the Canadian National at Stratford, Ont., has been appointed chief boiler inspector, with headquarters at Toronto, Ont.

Purchasing and Stores

F. C. Holton, assistant superintendent motive power of the Virginian, has been appointed purchasing agent, with headquarters as before at Norfolk, Va., to succeed D. C. King, who has been appointed acting general manager. The position of assistant superintendent motive power has been abolished.

Obituary

M. V. Milton, chief boiler inspector of the Canadian National at Toronto, Ont., died on February 19. Mr. Milton was a past president and life member of the Master Boiler Makers' Association.

John J. Mansfield, who retired about five years ago as chief boiler inspector of the Central of New Jersey, died on January 30.

James J. O'Neal, superintendent of the car department of the Gulf, Mobile & Ohio, at Mobile, Ala., died on February 26, after a short illness. Mr. O'Neal was born at Arcadia, Mo., on March 3, 1869, and entered railway service on March 1, 1890, with the St. Louis, Iron Mountain & Southern (now part of the Missouri Pacific). In 1900 he entered the employ of the St. Louis, Memphis & South Eastern (now the St. Louis-San Francisco) and on January 1, 1905, went with the Mobile, Jackson & Kansas City (now part of the Gulf, Mobile & Ohio) as a general car foreman, later becoming superintendent of the car department.

W. F. Buscher, general master mechanic of the Minneapolis, St. Paul & Sault Ste. Marie, with headquarters at Minneapolis, Minn., died suddenly of a heart attack on February 6, at Minneapolis. Mr. Buscher was born at Green Bay, Wis., on June 15, 1880, and entered railway service on the Chicago, Milwaukee, St. Paul & Pacific as a machinist apprentice at Green Bay, later becoming a machinist. On December 26, 1906, he went with the Soo Line as an enginehouse foreman at Enderlin, N. D., and later served in that capacity at Harvey, N. D., Glenwood, Minn., and Superior, Wis. Mr. Buscher was promoted to assistant master mechanic at Wishek, N. D., on December 1, 1915; to master mechanic at Superior on May 1, 1918, and to general master mechanic at Minneapolis, Minn., on June 1, 1926.

J. H. Gimpel, assistant superintendent, car department, of the Wabash, with headquarters at Decatur, Ill., died on February 13. Mr. Gimpel was born on August 12, 1875, and entered railway service in 1891 as an apprentice on the Missouri Pacific. From 1899 to 1918 he was employed by the Mexican Central as general car foreman, and by the National Railways of Mexico, the Missouri Pacific, the Vera Cruz & Pacific, the St. Louis San Francisco and the Denver & Rio Grande Western as master car builder. During the World War he served the United States Railroad Administration as supervisor of car repairs for the Western region of the United States. In 1920 Mr. Gimpel became superintendent of shops of the Grand Trunk at Port Huron, Mich., and in 1922 entered the employ of the Wabash as assistant superintendent, car department, at Decatur.

Railway Mechanical Engineer

May 1941

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See page 169

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Backshop and Enginehouse:

Car Foremen and Inspectors:

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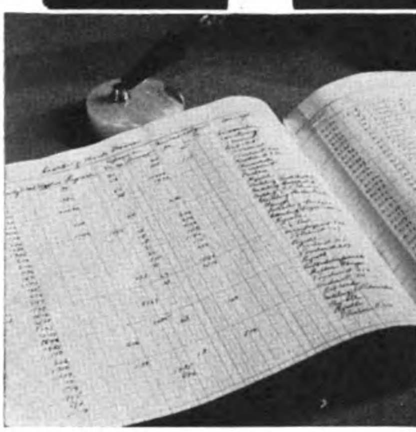

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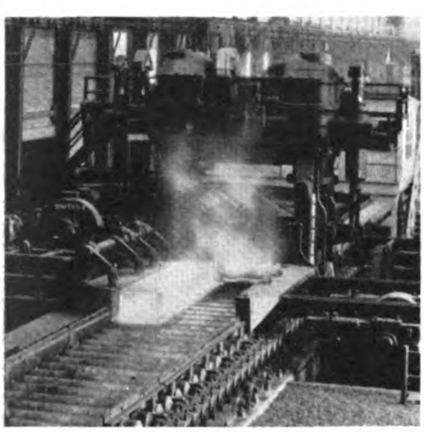

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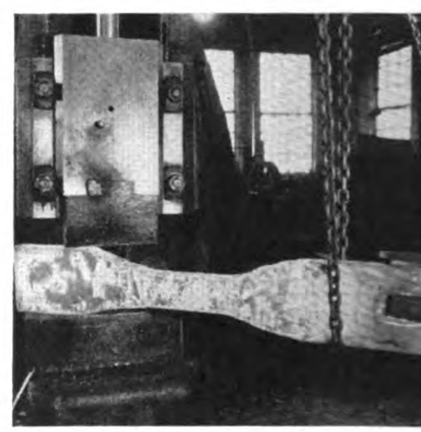

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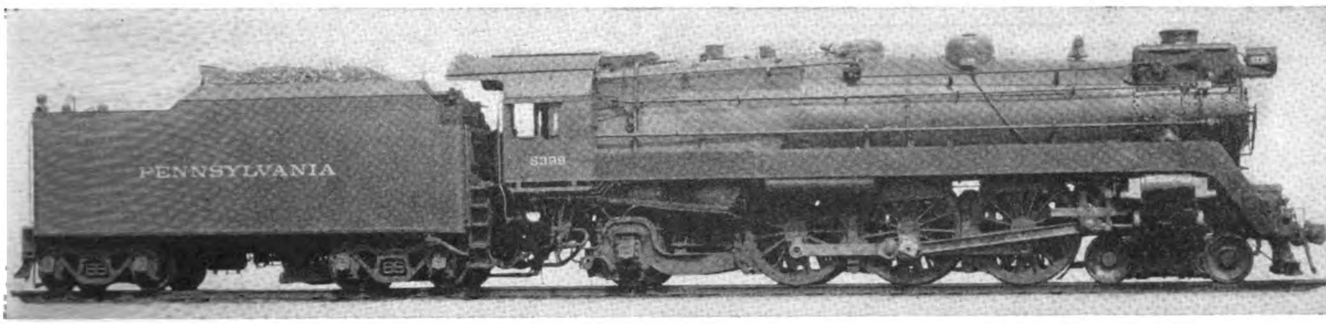


Locomotive No. 5399 after the installation of a new superheater header with the multiple throttle and type ASW single-pass superheater units

P. R. R. Locomotive with

Poppet Valves Tested at Altoona

Class K4s Pacific type No. 5399 subjected to an extensive series of plant tests in which it developed over 4,000 i.hp. at 100 m.p.h., an increase of over 40 per cent with a steam rate one third less than a piston-valve locomotive of the same class

In an extensive series of tests on the Pennsylvania Railroad test plant at Altoona, Pa., locomotive No. 5399, a Pennsylvania class K4s Pacific type equipped with the Franklin system of steam distribution, with O. C. poppet valves,* and a new single-pass Type ASW superheater, developed a maximum indicated horsepower of 4,267 at about 75 miles an hour and an indicated horsepower of 4,099 at 100 miles an hour. Compared with the indicated horsepower of a standard class K4s locomotive, at a steam consumption of 70,000 lb. per hour, No. 5399 showed an increase in indicated horsepower capacity of 16.2 per cent at 40 miles an hour, 17.1 per cent at 60 miles an hour, 22.9 per cent at 80 miles an hour, and 46.8 per cent at 100 miles an hour. Transposed into terms of steam economy, locomotive No. 5399 used 13.8 per cent less steam per indicated horsepower-hour at 40 miles an hour, 14.5 per cent less at 60 miles an hour, 18.4 per cent less at 80 miles an hour, and 31.7 per cent less at 100 miles an hour. While this improvement is largely due to the poppet valves, it should be stated that, in addition to the improved superheater, the No. 5399 was equipped with a larger dry pipe, front-end throttle, and larger steam pipes and exhaust passages, all of which contributed to the better performance. The highest net evaporation of locomotive No. 5399 was at 100 miles an hour, the highest speed tested, and amounted to over 77,000 lb. of water an hour.

The Test Program

Before the program of plant tests was started locomotive No. 5399 was taken into the shop for a new superheater. There was no change in the tube sheet or number of flues, but the original Type A superheater was removed and replaced with a new larger header, including the multiple throttle, and with single-pass Type ASW units, the pipes of which are bent in the form of a sine wave. Each unit consists of two loops in parallel, thus increasing the cross-sectional area of the steam

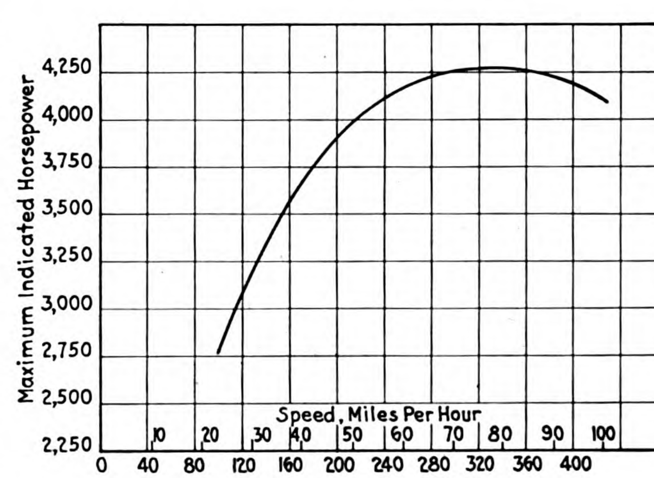


Fig. 1—The maximum indicated horsepower developed by locomotive No. 5399

* A description of the changes in this locomotive to fit it with the Franklin system of steam distribution and an account of the road tests and road service on the Pennsylvania Railroad appeared in the April *Railway Mechanical Engineer*, page 125.

passage through the units. Table I presents a comparison of the principal dimensions of the locomotive as it was tested on the road and as it was tested at Altoona. It will be seen that the area of steam passages has been increased so that the minimum restriction between the boiler and branch pipes has been increased from 45.5 sq. in., the area through the original superheater units, to 70.9 sq. in., the area through the new dry pipe, and that the minimum area between the superheater header and each cylinder has been increased from 28.27 sq. in., the area through one superheater-header outlet, to 48.56 sq. in., the area through two intake valves. There is also an increase of approximately 6 per cent in superheater heating surface due to the lengthening of the units and the use of sine-waved unit pipes.

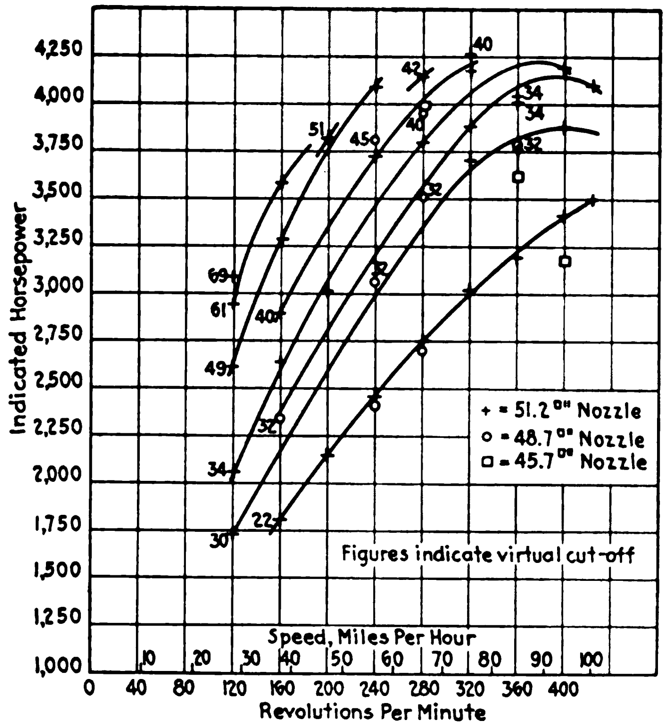


Fig. 2—The relationship of indicated horsepower to speed for various cut-offs of locomotive No. 5399

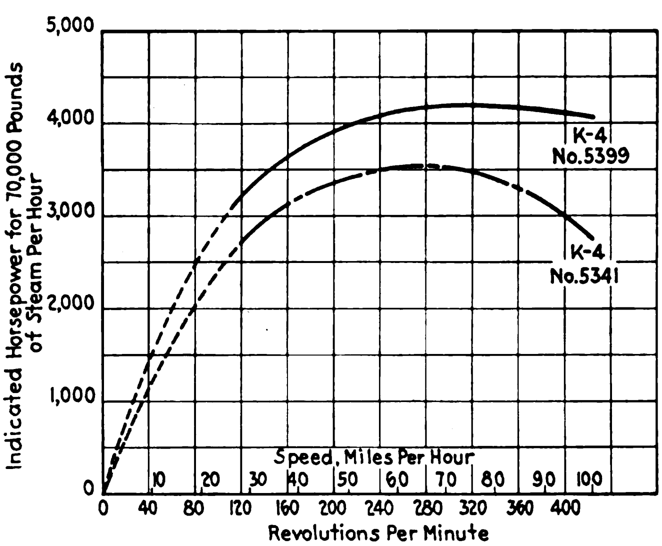


Fig. 3—Comparison of the indicated horsepower output of locomotives Nos. 5399 and 5341 for a uniform cylinder consumption of 70,000 lb. of steam per hour

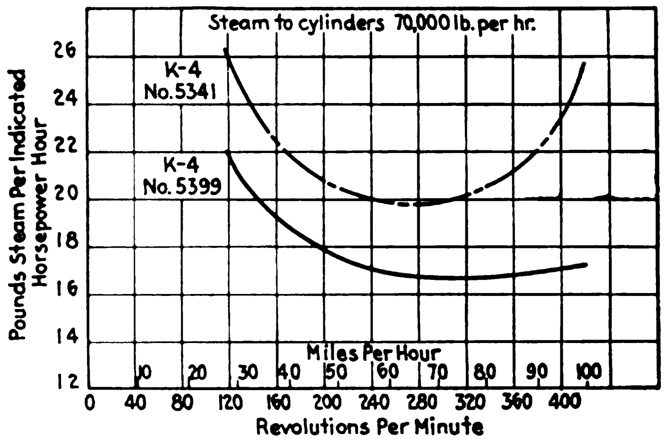


Fig. 4—Water rates of locomotives Nos. 5399 and 5341 for a uniform cylinder consumption of 70,000 lb. of steam per hour

The total engine weight of the standard K4s Pacific type locomotive is 320,000 lb. In Table I it will be seen that at the time of the road tests following the installation of the Franklin steam distribution system the weight was 330,800 lb. Following the installation of the new superheater and header the weight was 340,580 lb.

The test-plant program included a total of 56 test runs. These were divided in three series, each with a different size exhaust nozzle. The main series of 38 tests was run with a nozzle having a discharge area of 51.2 sq. in.; 15 tests were run with a 48.7-sq. in. nozzle, and three tests with a 45.7-sq. in. nozzle.

The best performance was obtained with a nozzle area of 51.2 sq. in., but the results with the 48.7-sq. in. nozzle were only slightly less favorable than those obtained with the larger nozzle.

The observations included all factors affecting boiler capacity and efficiency, cylinder performance, and machine efficiency. In this article for the most part consideration will be confined to those factors directly affecting evaporation and superheater performance, and cylinder and machine performance, all of which are affected by the steam-distribution system and the change in the superheater. The conditions under which the locomotive was tested in the main test series are set forth completely in Table II.

Table I—Dimensions and Weights of Pennsylvania Locomotive No. 5399

	At time of road test	At time of test-plant tests
Tractive force, lb.	44,460	44,460
Weight on drivers, lb.	208,800	216,930
Total weight, lb.	330,800	340,580
Driving wheels, diameter, in.	80	80
Cylinders, diameter and stroke, in.	27 x 28	27 x 28
Boiler pressure, lb.	205	205
Grate area, sq. ft.	68.7	68.7
Steam flow area, sq. in.:		
Max., through throttle	54.6	...
Through dry pipe	56.7	70.9
Through superheater subheaders	...	80.0
Through superheater units	45.5	...
Through double superheater units	...	91.0
Through multiple throttle	...	85.5
Through one header outlet	28.27	50.2
Through one steam pipe	50.2	50.2
Through two intake valves	48.56	48.56
Through steam port	54.0	54.0
Through two exhaust valves	68.0	68.0
Min., through one exhaust passage	68.0	68.0
Heating surfaces (fire side), sq. ft.:		
Firebox	311	311
Tubes and flues	3,375	3,375
Total evaporative	3,686	3,686
Superheater	1,205	1,277
Comb. evap. and superheater	4,891	4,963

Table II—Program of Tests of Locomotive No. 5399 Conducted at the Altoona, Pa., Test Plant

(Series with 51.2-Sq. In. Nozzles)

Nominal cut-off, per cent	Revolutions per minute								
	120	160	200	240	280	320	360	400	423
	(Figures in the columns below are the virtual cut-offs* at which the tests were actually run)								
15	8†	22	[1]22	22	22	[1]22	[4]22	[1]22	[3]22
20	30	..	..	..	..	30	30	30	30
30	..	..	..	..	[1]34	[3]39**	..	34**	[5]33
35	[1]34	[1]34	[1]34	[1]40	42	..	34**	..	..
40	..	40	..	..	..	..	..	..	..
45	49	49	49	..	..	..	..	..	..
50	..	..	..	[2]49	..	..	..	..	..
52½	..	..	51	..	..	..	..	..	..
55	61	61	..	..	..	..	..	..	..
68	69	..	..	..	..	..	..	..	..

[1] Lowest water rate at each speed (see Table III)
[2] Maximum db. hp. (see Table V)
[3] Maximum i. hp. (see Table V)
[4] Lowest water rate (see Table V)
[5] Maximum boiler output (see Table V)

* Virtual cut-offs are taken at 2-deg. camshaft swing before valve closure, corresponding to approximately 1/64-in. valve opening.
† Obtained from indicator-card marking.
** Tests repeated.

Cylinder Power and Steam Rates

The principal results of the tests are presented in a series of graphs. Fig. 1 shows the maximum indicated horsepower characteristics of locomotive No. 5399. It is worthy of note that the curve is relatively flat over a considerable range of speed and that at 100 miles an hour the locomotive is still capable of developing more than 4,000 i. hp.

In Fig. 2 the indicated horsepower-speed relationships of the tests at the various cut-offs are shown and uniform cut-off lines have been laid in. These lines indicate the conditions at which the maximum indicated horsepower was attained at the various speeds.

Fig. 3 is a graphical comparison of the indicated horsepower performance of locomotive No. 5399 with that of another K4s locomotive, No. 5341, which was tested at Altoona in 1937. These curves are plotted for a uniform cylinder steam consumption of 70,000 lb. per hour and, therefore, present an indication of relative economy as well as of indicated horsepower capacity. They show an increase in indicated horsepower in favor of locomotive No. 5399 of 16.2 per cent at 40 miles an hour, 17.1 per cent at 60 miles an hour, 22.9 per cent at 80 miles an hour, and 46.8 per cent at 100 miles an hour.

The economy aspect of the poppet-valve system of steam distribution is more clearly shown in Fig. 4 which compares the pounds of steam per indicated horsepower-hour at the 70,000-lb.-per-hour consumption rate for the two locomotives. The best economy of No. 5399 at this rate of steam consumption is 16.7 lb. per i. hp.-hr. at 75 miles an hour. In the case of locomotive No. 5341 the best steam rate at this rate of consumption is 19.8 lb. per i. hp.-hr. and was attained at about 65 miles an hour. At 85 miles an hour No. 5399 developed an indicated horsepower for 16.8 lb. of steam per hour, while the consumption for 5341 is 21.2 lb. per hour, and for higher speeds the difference increases rapidly.

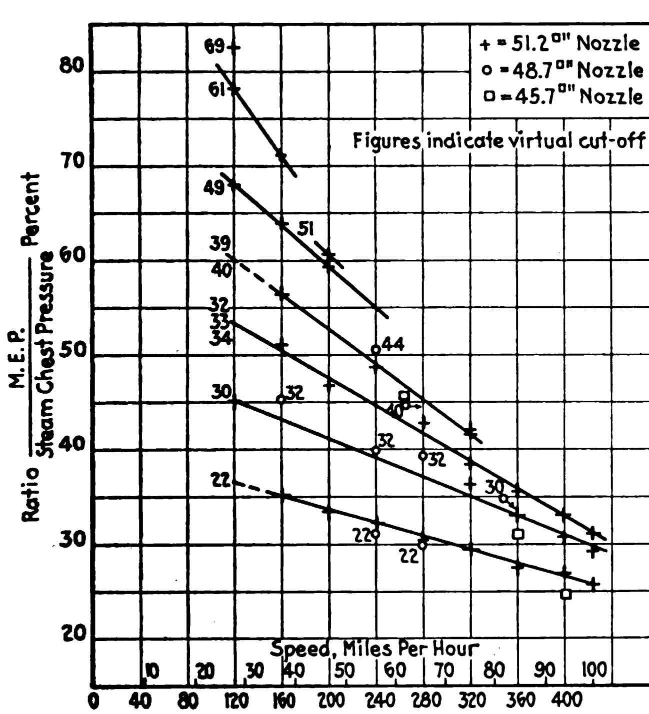


Fig. 5—How the ratio of mean effective pressure to steam-chest pressure varied with speed for each cut-off at which the locomotive was operated

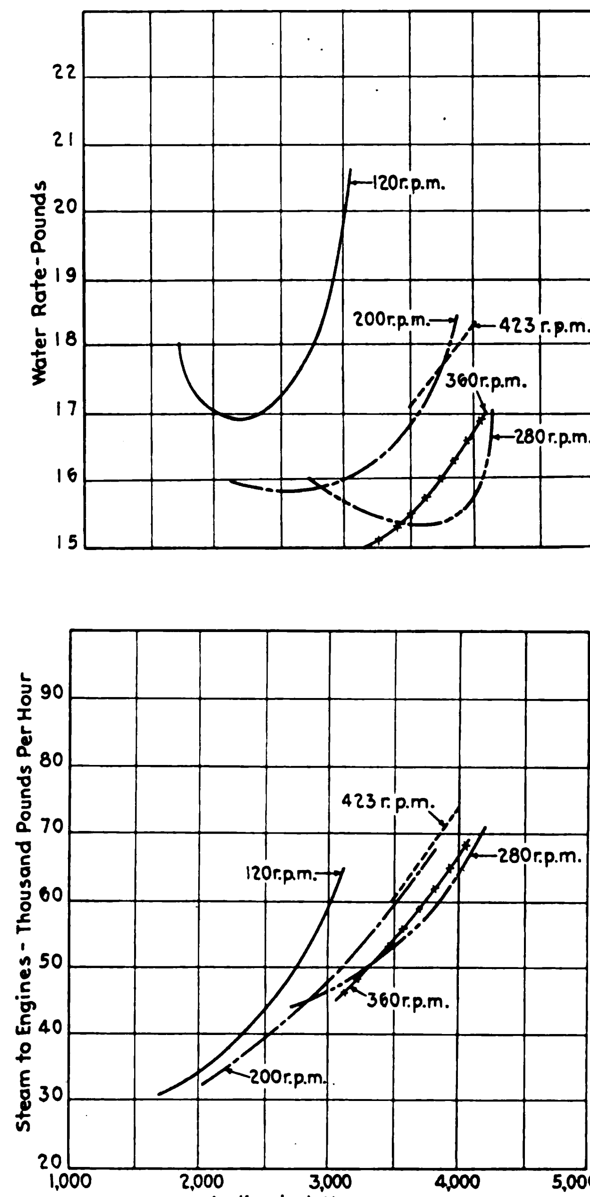


Fig. 6—Water rate and total steam-consumption curves for each of five selected speeds

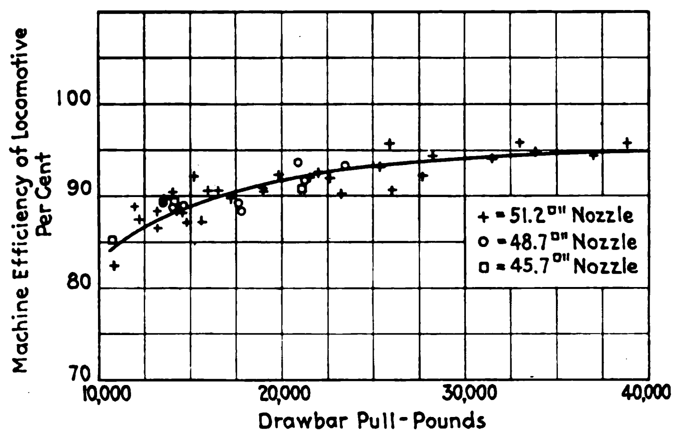


Fig. 7—The relation of machine efficiency to drawbar pull of locomotive No. 5399

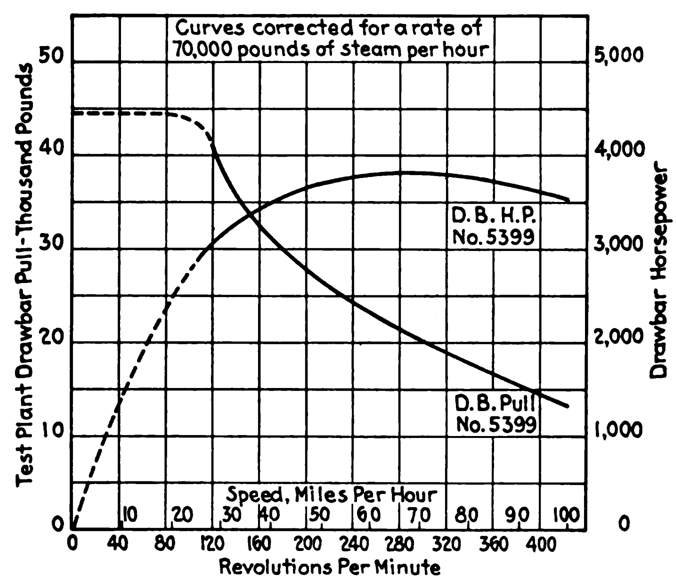


Fig. 8—The maximum drawbar-pull and drawbar-horsepower characteristics of locomotive No. 5399

The consistency of cylinder performance with changes in speed and cut-off is shown clearly in Fig. 5. Here the ratio of mean effective pressure to steam-chest pressure in per cent is plotted against the speed of the locomotive. The variations of the individual test values from the uniform cut-off lines are slight and a regular straight-line decline in the ratio of mean effective pressure to cylinder pressure is indicated as the speed increases. Like Fig. 2, this chart also indicates that the maximum mean effective pressure and indicated horsepower at the highest speed were attained with a cut-off of about 33 per cent. Shorter cut-offs will not develop the full capacity of this locomotive at speeds up to 100 miles an hour.

The trend of the relationship between total steam consumption and horsepower and the water rate and horsepower for various locomotive speeds are shown in Fig. 6. Tests were run at intervals of 40 r. p. m. Because of the relatively small spread of the values, however, clearness required the omission of curves for alternate values. Those plotted show speeds 80 r. p. m. apart, beginning with 120 r. p. m. It will be seen that for a given total steam consumption the horsepower increases with the speed up to 280 r. p. m. and then decreases for 360 r. p. m. and the maximum speed of 423 r. p. m. In the case of the water rate the minimum consumption decreases and occurs at progressively higher indicated horsepowers for speeds up to 280 r. p. m. Above these speeds a given water rate is obtained at progressively lower horsepower outputs.

Table III—The Minimum Water Rate at Each Speed

(See also Table II)

Speed, r.p.m.	Virtual cut-off	Net water evaporated per hr., lb.	Steam to cylinders per hr., lb.	I. hp.	Water rate
120	34	35,760	34,790	2,063	16.9
160	34	43,304	42,318	2,640	16.0
200	22	35,274	34,265	2,146	16.0
	34	49,236	48,178	3,013	16.0
240	40	60,144	58,964	3,730	15.8
280	34	59,224	58,186	3,798	15.3
320	22	49,080	48,060	3,022	15.9
360	22	48,716	47,776	3,191	15.0
400	22	55,294	53,612	3,407	15.7
423	22	61,020	59,918	3,502	17.1

Supplementing Fig. 6, in Table III is shown the lowest water rate attained at each speed at which the locomotive was tested and the accompanying indicated horsepower. The pattern of the cut-offs for maximum economy is also shown in this table as well as in Table II.

The curves in Fig. 6, like Fig. 4, show that the range of best economy comes within the working range of speeds and horsepowers.

Drawbar Power and Machine Efficiency

The machine efficiency of the locomotive plotted against drawbar pull is shown in Fig. 7. From a value of 85 per cent at about 11,000 lb., the efficiency rises to a maximum of about 95 per cent at 40,000 lb. The median values shown by the curve have been applied to the indicated horsepower curve for 70,000 lb. of steam per hour to produce the values shown on Fig. 8, the drawbar horsepower curve.

One factor bearing upon the relatively high machine efficiency of locomotive No. 5399 is the small horsepower required to drive the valves and valve gear. No data segregating the power required for this purpose are available from the test-plant tests of the locomotive, but tests were made showing the power required to drive the gear box, cam box, and valves in the steam chests in the laboratory of the manufacturer. These values at various

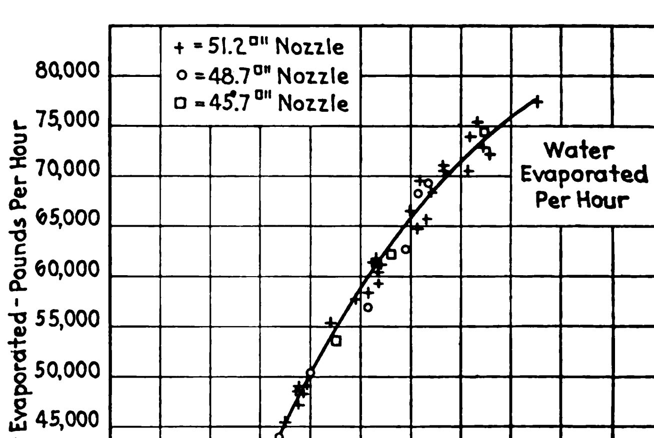


Fig. 9—The relation of net water evaporated to the coal fired for locomotive No. 5399

speeds are shown in Table IV. While the character of the drive between the gear box and the crosshead of the locomotive differs from that employed at the test plant, the figures indicate that an extremely small percentage of the friction horsepower of the locomotive is required to actuate the valves.

Boiler Performance

The performance of the boiler is shown in two charts. Fig. 9 shows the net water evaporated in pounds per hour in relation to coal consumption. It shows a maximum capacity of over 77,000 lb. with no indication of a marked change in the trend of the water-coal relationship at the higher boiler outputs. In Fig. 10 are shown the temperature of the steam at the steam chest and the degrees of superheat plotted against coal. In a number of individual tests within a range of coal consumption between 10,000 and 13,000 lb. per hour, steam temperatures slightly above 650 deg. were developed. These values range between a net water evaporation of about 58,000 lb. and 67,000 lb. per hour.

Selected Test Runs

The principal data from four tests are shown in Table V. These are the tests in which maximum indicated horsepower, maximum drawbar horsepower, maximum speed and boiler output, and maximum economy were attained. The maximum indicated horsepower was obtained at a speed of 75.8 miles an hour with a virtual cut-off of 39 per cent and a mean effective pressure of

Table IV—Horsepowers Required to Drive the Franklin Steam Distribution System

(Data from Tests in the Manufacturer's Laboratory)

R.p.m.	Horsepower
210	0.05
250	0.06
300	0.41
350	1.05
400	1.40
450	1.73
500	3.3

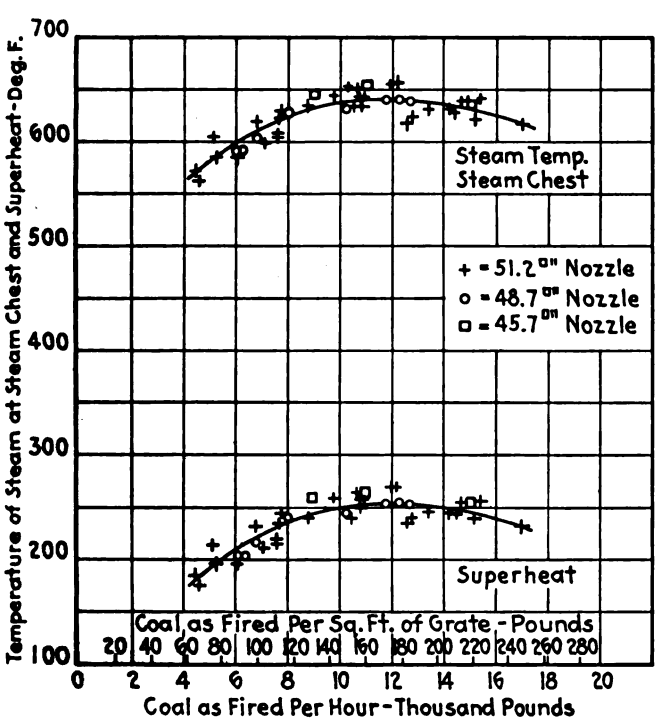


Fig. 10—Steam-chest steam temperature and superheat of locomotive No. 5399 in relation to the pounds of coal fired

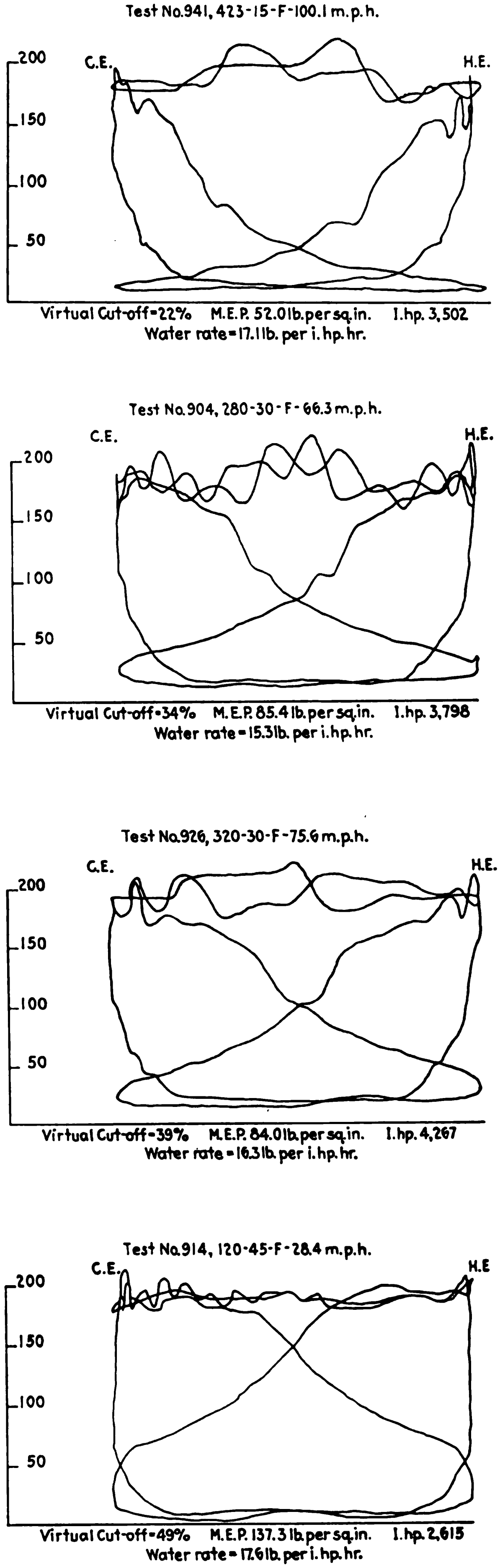


Fig. 11—Selected indicator cards taken from the right cylinder of locomotive No. 5399 at various cut-offs and speeds

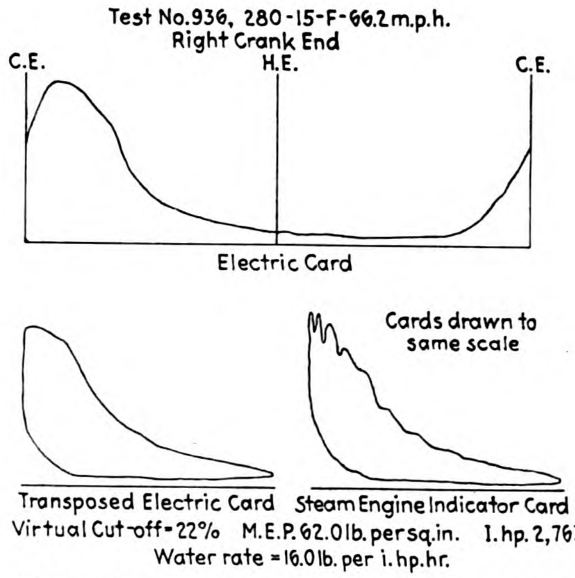
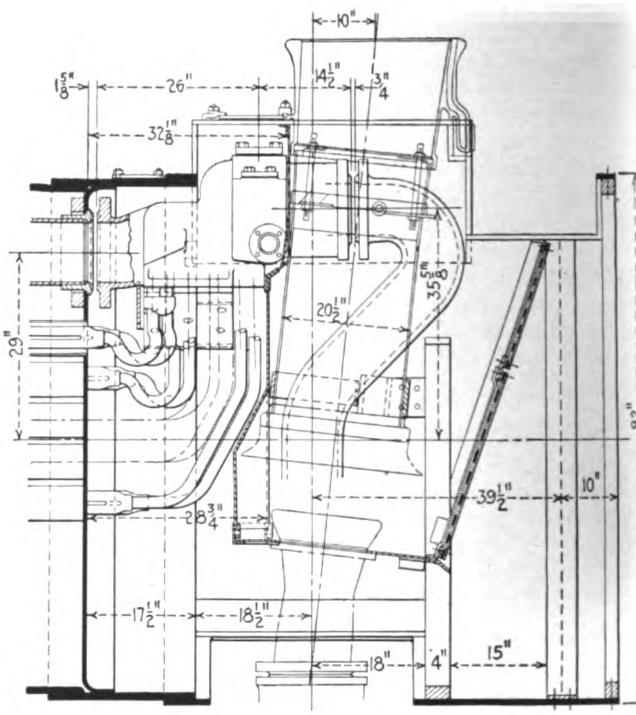


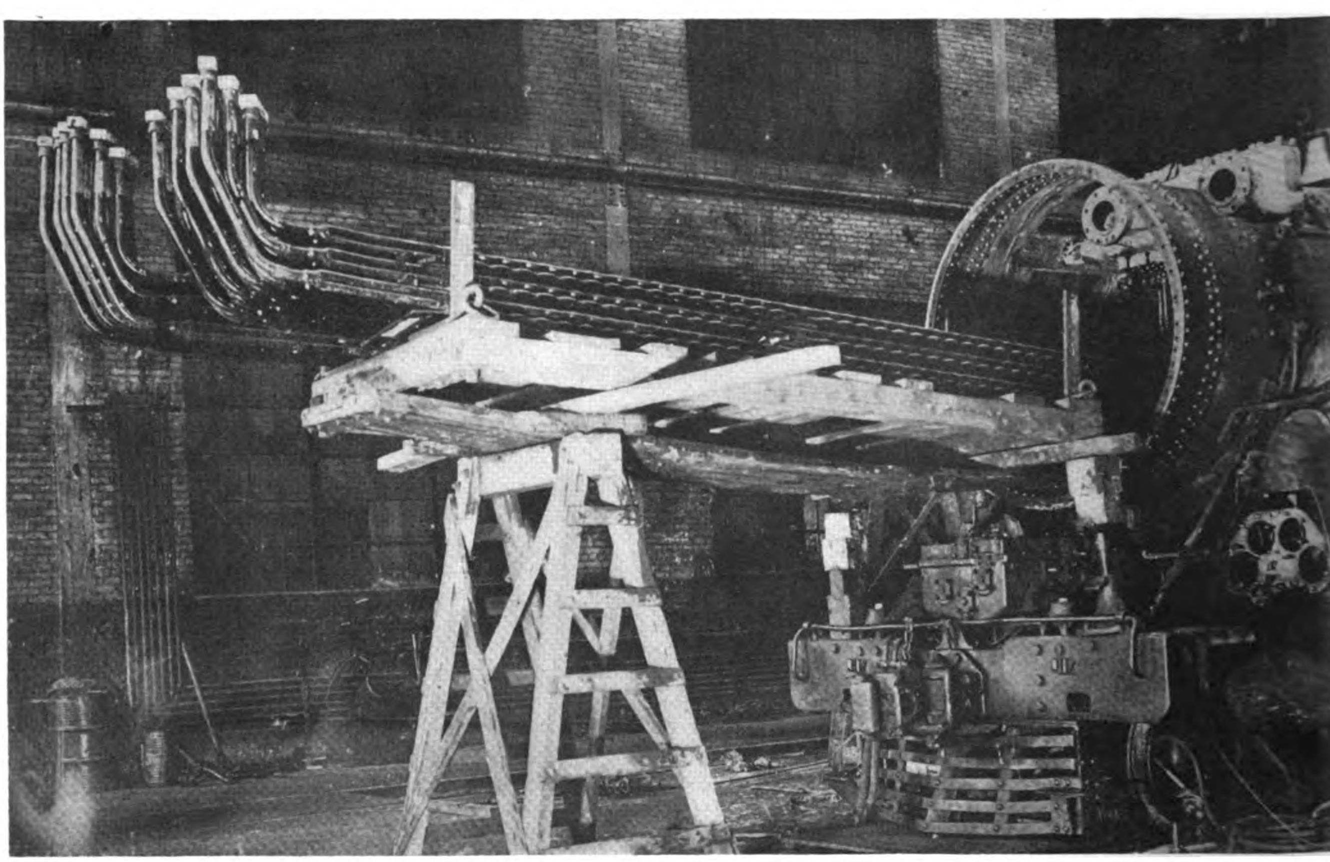
Fig. 12—How the electric indicator card compares with the cards taken from the steam-engine indicator

84 lb. per sq. in. The indicated horsepower was 4,267 which was developed with a consumption of steam at the cylinders of 69,430 lb. per hour and a net water evaporation of 70,585 lb. of water per hour. The maximum drawbar horsepower of 3,934 was developed at 56.8 miles an hour with a virtual cut-off of 49 per cent. The machine efficiency in this test was 95.6 per cent. Several other tests equalled or slightly exceed this one in machine efficiency, but 1,188 lb. of friction drawbar pull was the lowest recorded in any of the tests.

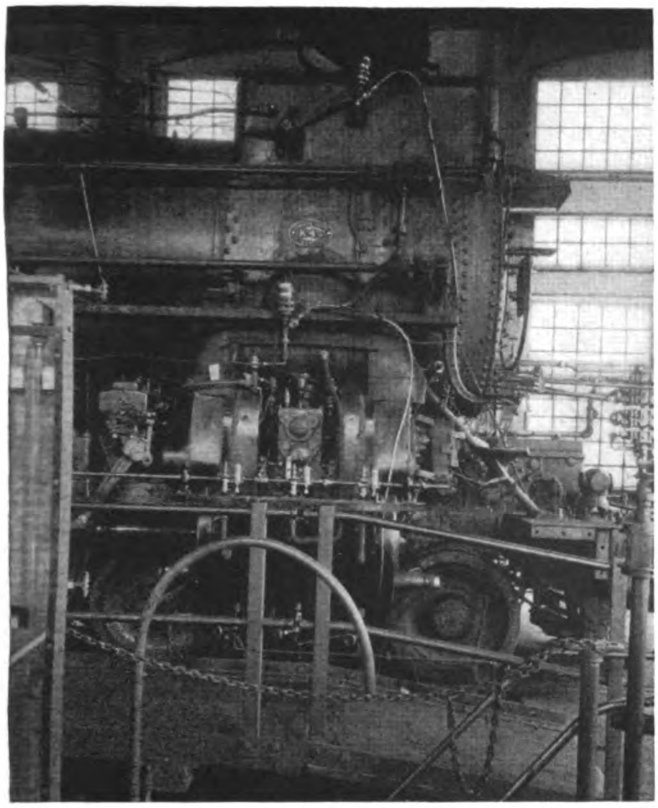
The maximum boiler output was obtained at 100 miles an hour and 33 per cent cut-off. In this test the net evaporation was at the rate of 77,480 lb. of water per hour, of which 76,208 lb. passed through the cylinders, developing 4,099 i. hp. Maximum economy was obtained in a test at 85.2 miles an hour with a virtual cut-off of 22 per cent and a net evaporation of 48,715 lb. of



How the front-end was arranged to accommodate the type ASW superheater on locomotive No. 5399



Type ASW superheater units being installed in locomotive No. 5399



Locomotive No. 5399 in the Pennsylvania railroad test plant at Altoona

Table V—Data from Selected Tests of Pennsylvania Locomotive No. 5399 with Franklin Steam Distribution System and Type ASW Single-Pass Superheater

(51.2 Sq. In. Exhaust Nozzles)

Test number	926	903	927	938
Selected because of	Max. i. hp.	Max. db. hp.	Max. speed; max. boiler output	Max. economy
Designation—r.p.m., cut-off, throttle	320-30-F.	240-50-F.	423-30-F.	360-15-F.
Virtual cut-off, per cent	39	49	33	22
Duration, hrs.	0.2	0.5	0.5	0.5
Speed, m.p.h.	75.8	56.8	100.0	85.2
Temperature, deg. F., steam in steam pipes to locomotive cylinders	632	639	617	608
Boiler pressure, lb.	205	204	203	205
Pressure drop between boiler and steam chest (total), lb. per sq. in.	10.5	9.6	10.8	7.7
Superheat, deg. F., steam in steam pipes to locomotive cylinders	246	254	233	221
Superheat, deg. F., exhaust steam from locomotive cylinders in exhaust passages	45	52	54	8
Net water evaporated, lb. per hr.	70,585	75,250	77,480	48,716
Equiv. evaporation, lb. per hr.	94,985	101,244	103,790	64,945
Equiv. evaporation, lb. per hr. per sq. ft. heat. surface	19.1	20.4	20.9	13.1
Superheated steam, lb. per hr.	69,430	73,934	76,208	47,776
Mean effective pressure, lb. per sq. in.	84	107.9	61	56
Indicated horsepower, total	4,267	4,114	4,099	3,191
Water rate, steam per i. hp.-hr., lb.	16.3	17.97	18.6	15.0
Drawbar horsepower, total	3,862	3,934	3,547	2,790
Drawbar pull, lb.	19,110	25,961	13,301	12,282
Water rate, steam per db. hp.-hr., lb.	18.3	19.1	21.8	17.5
Tractive force based on mean effective pressure, lb.	21,122	27,152	15,373	14,048
Locomotive friction, hp.	405	180	552	401
Locomotive friction, pull at drawbar, lb.	2,004	1,188	2,070	1,765
Machine efficiency, per cent	90.5	95.6	86.5	87.4
Steam per i. hp.-hr., lb. (calculated from heat drop in cylinders)	17.1	17.1	18.6	15.7
Difference between steam per i. hp.-hr. from heat drop and from indicator cards as a percentage of water rate, steam per i. hp.-hr.	+4.9	−4.8	0.0	+4.7
I. hp. calculated from heat drop in locomotive cylinders	4,060	4,324	4,099	3,043

water an hour. The locomotive developed 3,191 i. hp. with a cylinder consumption of 15 lb. of steam per horsepower-hour.

A selection of indicator cards representing several speeds and cut-offs are reproduced in Fig. 11. The best single indication of the effect of the characteristics of the poppet valve (i. e., quick opening and closing with a high percentage of full port areas between these events) is shown by the card selected from test No. 941 at 100.1 miles an hour and 22 per cent virtual cut-off. This card developed a mean effective pressure of 52 lb. per sq. in. and the indicated horsepower was 3,502.

Indicated horsepower calculations were made from the conventional steam-engine indicator cards. A qualitative comparison of these cards with those taken at the same time with electric indicators is shown in Fig. 12. The electric indicator, the measuring element of which is a diaphragm free from the effect of inertia forces, produces a smooth card with the events clearly defined. These cards are considered conclusive evidence that the irregularities of the cards from the conventional indicator are caused by conditions inherent in the indicator itself and do not reflect pressure irregularities in the locomotive cylinder.

* * *

The City of Midland, flagship of the Pere Marquette's car-ferry fleet, made its first trip March 12 between Ludington, Mich., and Milwaukee, Wis.

A 250-ton well car built for the Carnegie-Illinois Steel Corporation by the Greenville Steel Car Company

A Welded

High-Capacity Well Car

The well body consists of seven heavy H-beams, the flanges of which are arc welded together—The ends and well portion of each beam are rolled-sections; the curved transition pieces, fabricated sections, all joined by Thermit welding—The well body is carried on four six-wheel trucks

A WELL car, 90 ft. long over the coupler pulling faces with a load capacity of over 250 tons, has been built for the Carnegie-Illinois Steel Corporation by the Greenville Steel Car Company. The car is for use in carrying ingot molds between two Carnegie-Illinois plants and is completely fitted for regular interchange movements. Aside from its great size and high load-carrying capacity, the car is unusual in that the completely welded body involved the use of Thermit welding as well as arc welding in its fabrication and because the load is carried on four six-wheel trucks, two under each end.

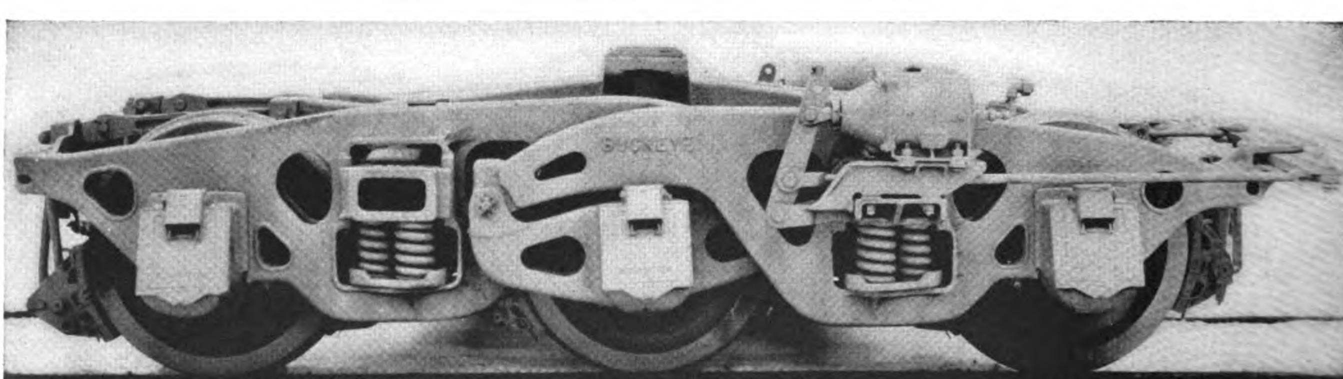
The car consists of two auxiliary bodies on the center sills of each of which are center plates which rest on two of the six-wheel trucks and in one end of each of which is mounted the coupler and draft gear. The inner end of each auxiliary body terminates at the bolster. The well body is carried on the two auxiliary bodies through large center plates.

The trucks are the Buckeye six-wheel type with 36-in. rolled-steel wheels mounted on axles with 7-in. by 14-in. journals. The wheel base of each truck is 10 ft. The truck castings are of Grade B steel.

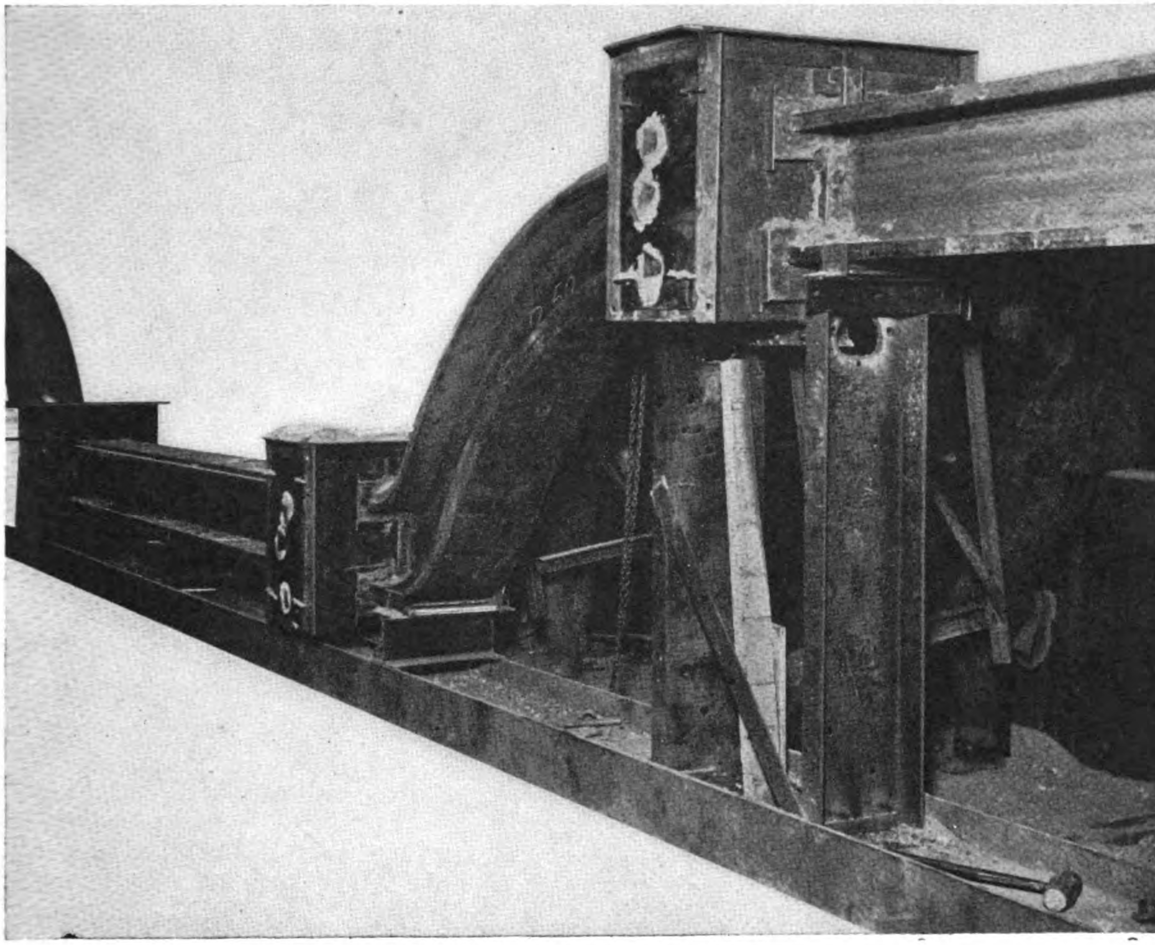
The brakes consist of two sets of AB equipment with special features, furnished by the Westinghouse Air Brake Company, and eight 10-in. by 8-in. brake cylinders, one on each side of each of the four trucks. On each auxiliary body is mounted the standard AB valve with its double compartment reservoir, a relay valve, and a separate auxiliary reservoir. The AB valve directly controls the pressure in two of the brake cylinders and this, in turn, operates the relay valve which serves to develop a corresponding pressure in the other two from the separate auxiliary reservoir. Each cylinder actuates the clasp brake rigging for its set of three wheels. Flexible armored hose is used in the brake-pipe line between the well body and the auxiliary bodies and in all the brake-cylinder pipe connections. There is a hand brake on each end of the car and each hand brake operates the brakes on the two six-wheel trucks applied under that end of the car.

The total weight of the car is 313,900 lb., of which 107,920 lb. is in the four trucks, 49,000 lb. in the two auxiliary bodies, and 156,980 lb. in the well body proper. The pay-load capacity at a rail load limit of 70,000 lb. per axle is 526,100 lb.

The car body is fabricated by arc welding, together, longitudinally, seven long H-beams. Each H-beam, in



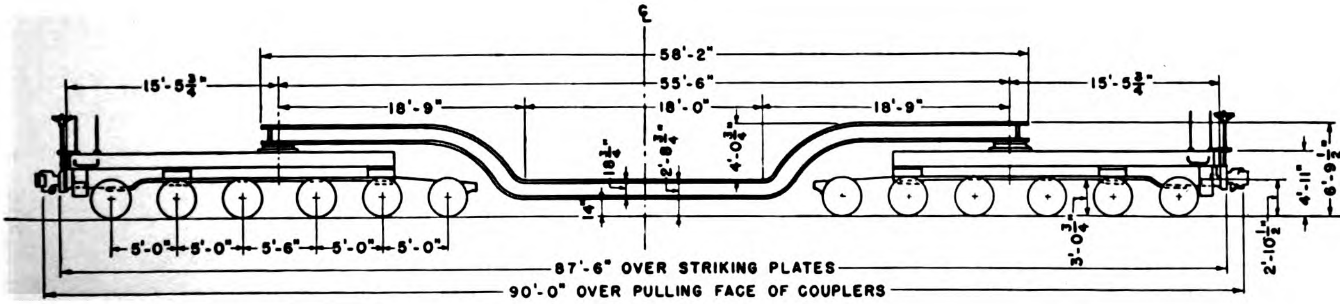
One of the Buckeye six-wheel trucks—The wrought-steel wheels are 36 in. in diameter

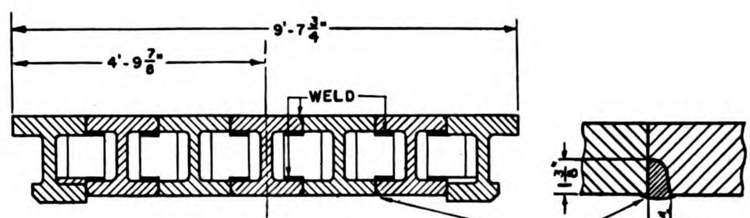


The parts of one of the well-platform beams set up for Thermit welding

turn, was made up of five separate pieces butt welded together by the Thermit process. These members comprise the central platform piece, two reverse-curve transition pieces, and two end pieces which terminate at the main bolsters. The two beams on the outside of the load-carrying platform are rolled steel, weighing 426 lb. per ft., and the five internal beams of the platform are rolled steel, weighing 370 lb. per ft. The pieces are of rolled sections, weighing 264 lb. per ft.

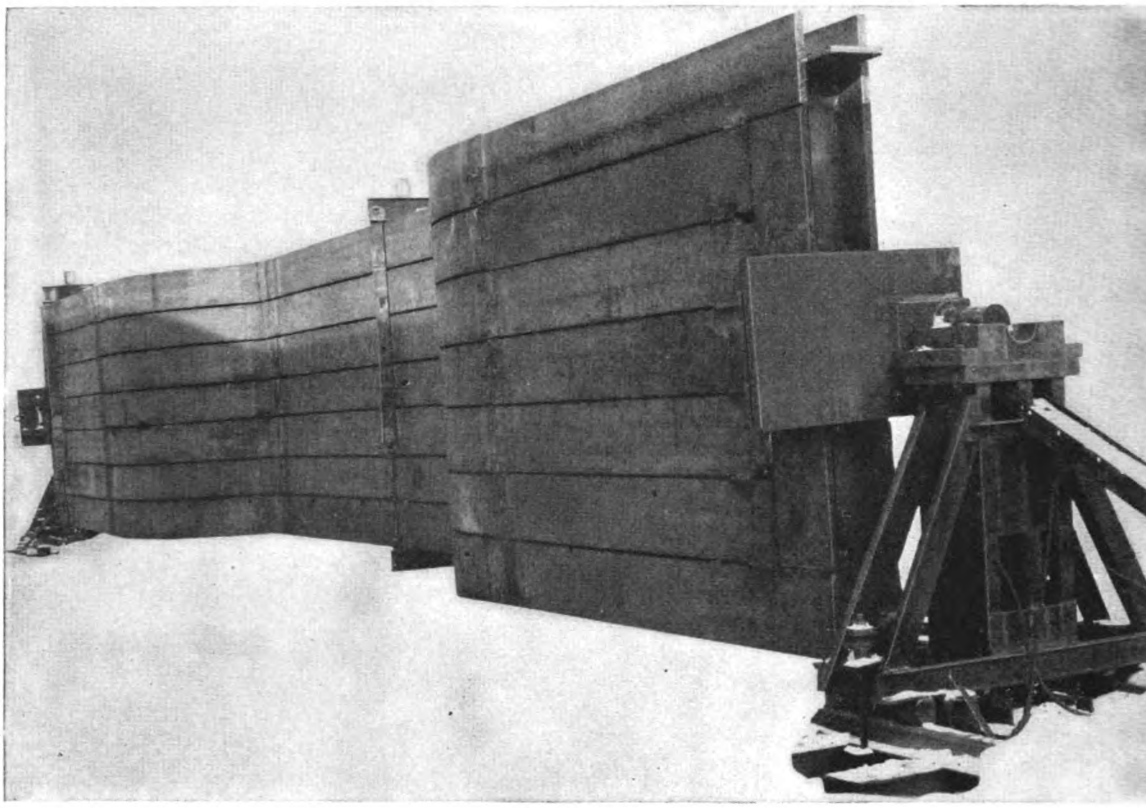
The curved transition pieces are fabricated beams 16 in. wide and tapering from 18¾ in. high at the bottom to 16½ in. high at the top. They are made up of 1¾-in. web pieces and 3-in. flange pieces. Web plates were flame cut to the required reverse curve and chamfered





SECTION OF BODY AT ℄

General dimensions of the well car and cross-section at the transverse center line showing the location of the arc welds by which the separate beams are joined to form the platform



The well platform assembled in the arc-welding jig—The Thermit weld collars on the beams are clearly shown

on each side to a depth of ¾ in. Top and bottom flanges were first machined with J-grooves at the edges for welding the beams together when complete, then bent to shape. The parts of each beam were assembled in a jig and the flanges were welded to the web in eight alternate passes on each side of the web. Three-quarter-inch fillets were then built up on top of these welds in six passes on each side. Following completion of the transition pieces, the succeeding step was the Thermit welding of the seven long beams for the body of the car. Because 28 welds, all alike, were to be made, patterns for forming molds could be used advantageously and the work could be set up on a production basis. Beams were fabricated in pairs. On the first day, for example, one beam was lined up in a jig and the four molds applied. Next day the welds on this beam were preheated, two at a time, and poured. At the same time, while preheating of the welds on the first beam was in progress, a second beam was lined up. On the third day molds were applied to the second beam, and on the fourth day these beams were heated and poured. When the welding of each pair of beams was completed, the work was interrupted until the welded beams could be removed and another pair set in place.

With the Thermit welding of the beams completed, seven diaphragm stiffeners on 3-ft. centers were welded into the channels on each side of three of the long beams. The two end bolster beams were then welded to the center beam at right angles and this sub-assembly was bolted in place in a positioning jig located over the rails where final assembly of the car was to be completed. This jig was equipped with trunions to permit revolving the assembly for compensation of warping and to enable all welds to be made downhand.

With the center beam and end bolster assembly in the jig, the remaining beams were dropped in place as required and each one welded in position. Continuous longitudinal welds the entire length of the platform and transition portions of the long beams were employed in welding the body of the car together. For this welding J-grooves 1⅝-in. deep and ¾ in. wide at the top had been machined before assembly in the outside edges of the center beam and the two beams next to the outside.

Warping was kept to a minimum by close control of heating the assembly during welding and by careful welding procedure. The entire assembly was maintained at about 200 deg. F. throughout the welding operation. The heating system devised, however, included a means of raising and lowering the temperature at various points, together with gages distributed at several places over the assembly to enable welding contractions to be measured and offset. Sufficient control was obtained in this manner so that the entire assembly could be raised or lowered a full inch by varying the temperature of the upper or lower flanges. Welding was started with 12 operators working in 10-hr. shifts and continued without interruption until the work was finished. With two operators working on each of the six seams, welding proceeded on one side of the car until the gages showed that the car body had been pulled ½ in. out of line. The whole assembly was then turned and welded on the opposite side until the body had been moved ½ in. out of line in the other direction. On an average, at the outset the work required turning twice in a 10-hr. shift; later this was increased to once in 10 hrs.

Although all of the welded steel was a copper-nickel alloy, mild steel welding electrodes were employed for the greatest part of the work.

Upon completion of the welding on the long beams and the end bolsters, the positioning fixtures were removed temporarily to permit inserting the end sills and then replaced so that the welding in of the end sills and body side bearings could be positioned. The jigs were then removed permanently and the center plates riveted and welded in place.

Automatic Spot-Welding in

Freight-Car Construction*

By John W. Sheffer†

Combined with arc-welding of roof and side-frame members, and riveting to join the roof, side, end, and underframe sub-assemblies on the track production line

WELDED construction of cars is not new, but it has had a slow growth. Our company built four welded tank cars back in 1908. These cars were gas welded and for welding electrodes we used scrap trimmings from the plate material used in the construction of the shell and heads. They were for Peru, S. A., and to the best of our knowledge have given satisfactory service.

At the South St. Louis plant in 1911 the American Car and Foundry Company built the first spot-welded freight car, with welding equipment of their own manufacture. A few rivets were used in the car, but only for the purpose of holding the erected members in place during the spot-welding operation. This method of holding the parts was used instead of jigs on account of the savings in cost, as but one car was built. This car was C. B. & Q. No. 71699 and had an official inspection with report in 1925. This report indicated the spot welding stood up to full expectation.

Over 25 years ago, to meet special applications, the company designed and manufactured more than 15 spot welders, several of which were portable. These were the first applications and use of portables. There were no such welders on the market.

During the twenties, welding became more and more extensively used, but it was still confined to car parts and miscellaneous products. Some of the welded items were at the junctions of window stooling, deck sills, and plates, door sills and headers, partitions, etc. The fusing of wire nails to the inside of sheathing to form fasteners for the application of insulation was one of the early applications of butt welding.

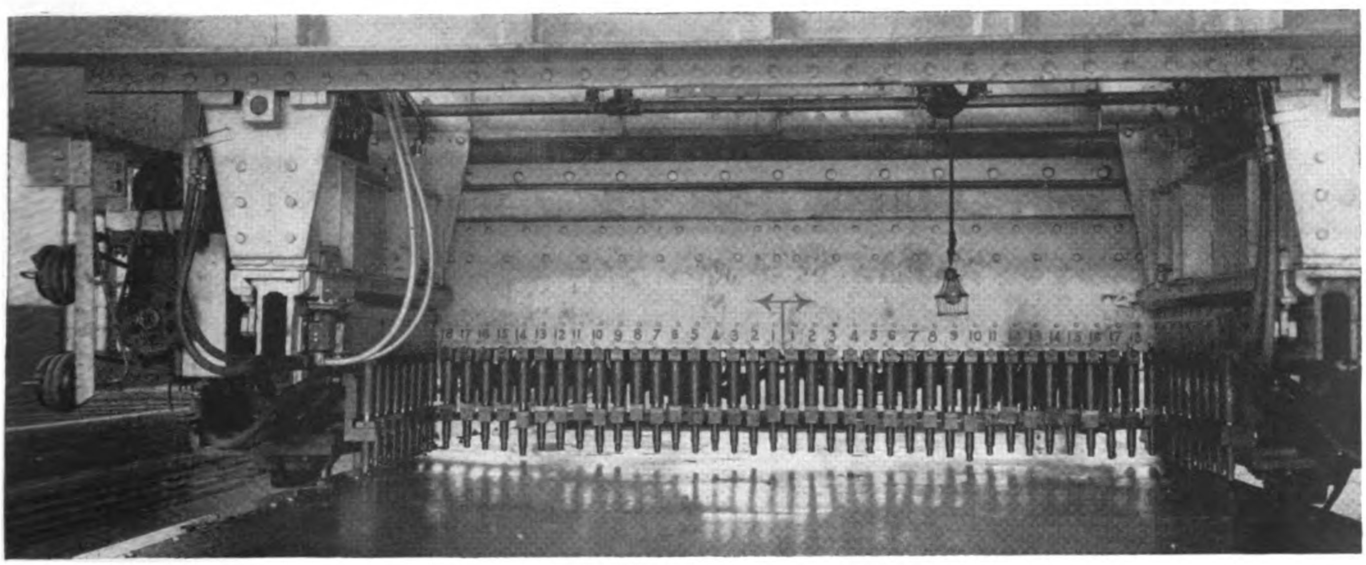
During the early thirties this builder made five 50-ton gondola cars for the Chesapeake & Ohio. These cars were equipped with one-piece cast-steel underframes. Floors and the superstructures were of welded construction. Later in the same year, a similar car was built, but with a structural-steel riveted underframe, the floors and superstructure being assembled by arc welding. These cars were placed in heavy service, were carefully watched, and the latest reports are very favorable toward arc welding.

Automatic Arc Welding

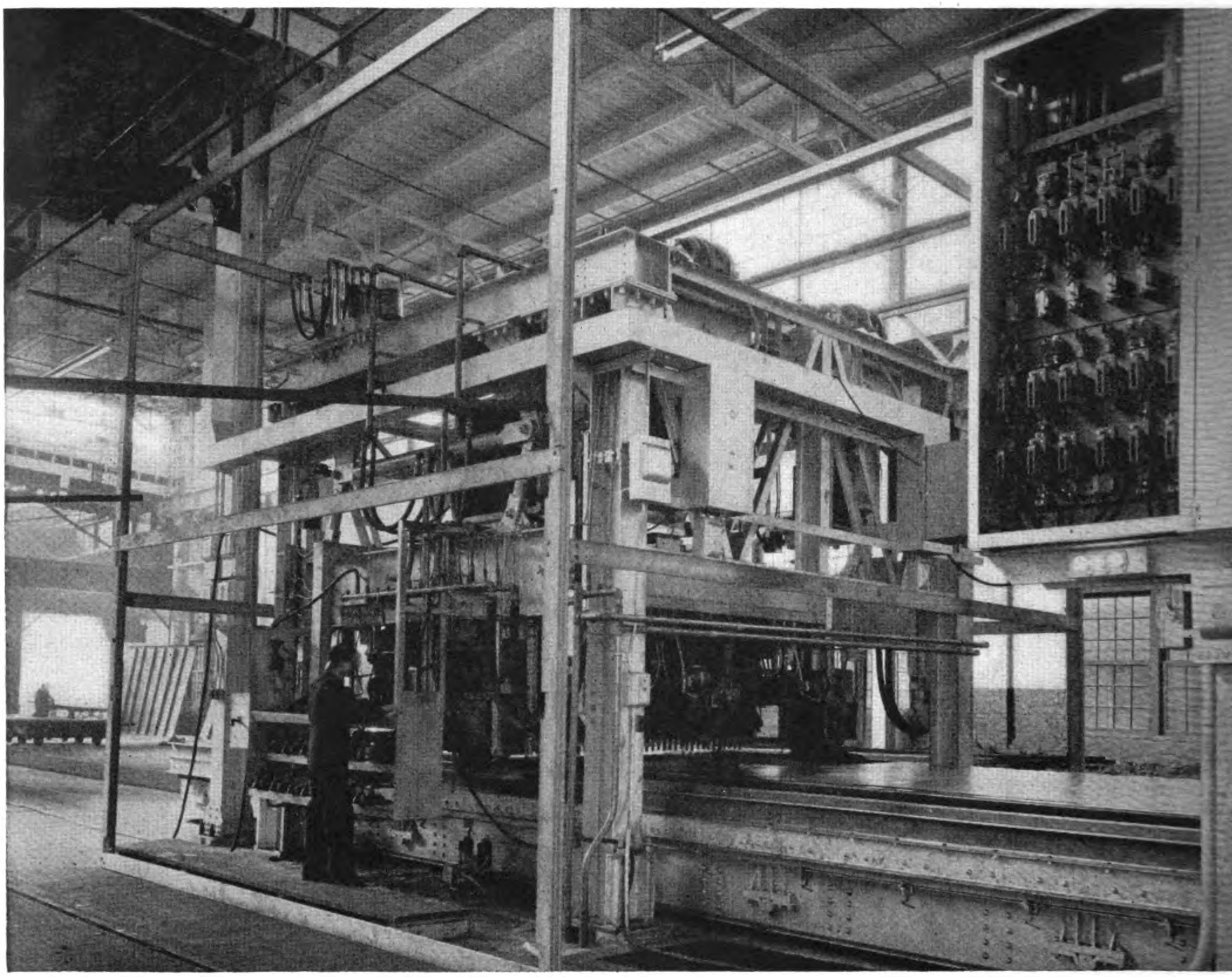
Since 1932, the American Car and Foundry Company has been building covered hopper cars for various commodities such as cement, carbon black, as well as other dry commodities. Without welding, it would have been impossible to have attained the smooth interior necessary for the discharge of the lading. At the present time, these covered hoppers are manufactured in quantities in which the whole car body, except the trucks, is welded. There is approximately 1,100 ft. of arc welding on this covered hopper body. One quarter of this is on the hopper sides and may be done automatically in sub-assemblies.

The use of automatic arc welding arises from the desire to obtain greater economy in labor and material, more uniform results, greater operating factor, higher welding currents which in turn measure greater production, and reduced fatigue on the operator. Automatic

* Abstract of a paper presented before the St. Louis, Mo., Section of the American Welding Society, April 11, 1941.
† Electrical engineer, American Car and Foundry Company.



The platen and electrodes of the car-side welding machine



Automatic spot welder which joins the sheathing to a box-car side frame in a single operation for each panel—The indexing of the jig car under the platen and the cycle of welding operations are performed by the operator at the left through push-button controls

arc welding is particularly adapted to high production welding where there are a large number of similar operations or where there is enough footage of the same type of welding to justify it, in which case a fairly expensive holding or clamping fixture can be justified.

Two of our shops manufacturing hopper cars are equipped with thyratron control, automatic arc-welding equipment, using the lightly coated coiled electrode. This is a special application on the welding of hopper-car side stakes to the sheets which act as stiffener members to those sheets and become integral with the car side-frame work.

Evolution of Automatic Spot Welding

In 1934, this builder designed spot-welded passenger cars of high-tensile low-alloy steel in which the exteriors of the cars were perfectly smooth. Two trains of these cars were delivered in 1935 and a third train in 1937. These trains were complete with Diesel-electric power cars. I refer to the Rebel trains running on the Gulf, Mobile & Northern between New Orleans, La., and Jackson, Tenn.

I direct this construction to your attention because it is a step in the development of spot welding on a production basis. We call it the panel-section type of spot-welded construction. The roof and sides were built up to 9-ft. 6-in. sections and assembled on the car by means of rivets through the vertical flanges of the side-post angles.

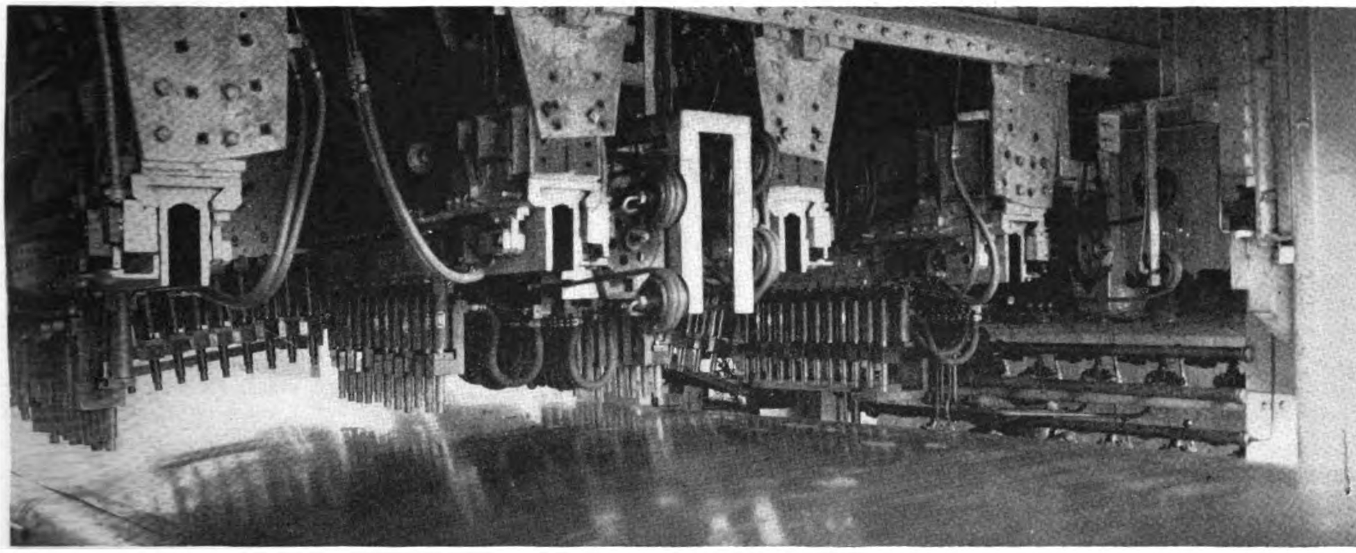
A specially built vertical-gap spot welder was located in a pit at the final spot-welding position, for attaching the side sheathing to the side sills. In these cars the underframe was completely riveted. Thus, we have passenger cars with a riveted underframe, separate panels for sides and roof of spot-welded construction, and final assembly of the three sub-assemblies by spot and arc welding and riveting.

As is usually the case, after the cars were delivered the next step was a study of improvements in production to determine what could be done to reduce the cost. This study developed many interesting things, but two predominant factors stood out as high lights to be followed in increasing production. First, if feasible, spot weld a complete side and complete roof with a machine capable of making welds both simultaneously and consecutively. Second, assemble these units finally into a complete shell by concealed rivets.

Production Welding of Freight Cars

During the year 1940, at our Madison, Ill., plant, equipment was installed and 400 lightweight box cars were produced of welded construction. The weight saving is over three tons per year.

Arc welding in the assembly of the A. A. R. Z-type



Electrode set-up for welding a roof panel in one operation

center sill, specially designed for welding, is now universally used in freight-car construction. In fact, owing to the wide variations in the thickness of the sections used for the various members in the car underframe, arc welding became the preferred method of assembly. However, accurate preparation is most important, so that excess weld metal is not required. There is but one seam that may be welded automatically; the others are too short to justify a set-up.

The various members of the underframe, such as bolsters, cross bearers and cross ties, are first fitted up and arc welded in sub-assembly jigs. The main assembly must have an accurate, sturdy jig which firmly holds the various parts to be assembled in their proper places, so they may be properly arc welded into one rigid unit. When production quantities permit, a rotating or positioning jig is provided. The freight-car ends are made up of several pressings arc welded together along their horizontal adjacent edges.

The unit system of fabricating underframe, sides, roofs and ends of freight cars by welding in jigs apart from the main track assembly permits positioning for horizontal arc welding when required and accessibility for more careful work and inspection. The final assembly by rivets of these main sub-assemblies in track production lines facilitates the desired output and secures economies in repairs at some future date.

The Automatic Spot Welder for Car Sides and Roofs

In fabricating the roofs and side units, spot welding is performed by special multiple spot-welding machines. This development in multiple spot-welding equipment, through the use of a multiple distributing switch in the secondary or heat-generating circuit, permits the entire group of electrodes to be put under pressure simultaneously. These electrodes act as a self-contained clamp at each and every weld location. They remain in that position through the entire cycle of individual electrode welding sequence. The facilities for applying the correct

Freight-car side-frame welding jig—An assembled side is shown in the jig car at the left

amount of pressure on all electrodes simultaneously and having them dwell until the various welds are sufficiently cool produce a clean, strong and uniform weld.

A multiple spot welder is made up of the following principal functions:

1—A constant-pressure hydraulic system for platen lift and electrode shift.
2—An adjustable-pressure hydraulic system, as supply to all electrode cylinders.
3—Multiple mounted transformer units as supply to multiple electrode groups.
4—Primary current supply to each transformer group through ignitron contactor and mechanical timing cams.
5—High-speed secondary distributing switches.
6—An indexing welding jig car covered with a secondary copper grillage.
7—A water-cooling system to transformer, secondary switches, distributing cable and electrodes.

These automatic multiple welding machines consist of an upper moving platen, upon which is mounted the multiple electrode set-up. One machine is used for car roofs and a second for car sides.

The panel welder for roofs has two welding jig cars which move on a track under the electrode platen and permit a continuous operation of the welder, roof after roof. The alternate jig car is loaded with a roof frame and roof sheets by the fitters and moves into the welder as soon as the other jig car vacates the welding position.

Preliminary to the spot-welding operations the roof framing and side-framing members are assembled in accurate jigs and firmly clamped into position. In the case of the roof, the carlines are arc-welded to the side plate and the purlins to the carlines. In the case of the side-framing members the posts are arc welded to the side-sill angle and the side plate.

The framing unit is then placed on the secondary copper grillage of the welding jig car which backs up the multiple electrodes. The sheets are fitted and clamped in position for spot welding. The motor-driven jig car through its push-button magnetic control is indexed to the panel to be spot welded.

The platen, with a set-up of the required number of electrodes, is lowered to contact the work through a push-button magnetic control valve from the constant-pressure hydraulic system. At the same time, the contact shoes at the direct welding transformers make contact with the copper bus-bar grillage at each side of the welding jig car. All the electrode cylinders are put under pressure simultaneously through manually operated valves and supply from the adjustable-pressure hydraulic system.

The motor-driven secondary distributing switches pass about twenty thousand amperes to each welding electrode connected to respective segments of the switches. These switches are started by push button and stopped by a limit switch at the end of their travel and are operated both forward and backward.

These secondary switches are operated simultaneously on three-phase closed-delta primary power supply with three welding transformers and three ignitron contactors available to supply current to the bus-bar power distribution. In this manner a panel of 70 to 80 spot welds may be divided and made in one-half the time. Two of these secondary switches are operated consecutively to segregate a group of about 32 spots in sequence of 19 and 13 spots respectively. No. 3 secondary switch is operated two welds at a time as in series spot welding. Adjustable timing cams operate the micro switch attached to the trolley of each secondary distributing switch and determine the desired timing of each spot.

Intermediate spacing of spots requires a 1-in. lift of the platen and a 1-in. and 2-in. shift of the electrode mounting and shifting slide. The panel cycle is then repeated as required to meet the spacing required. When the panel cycle is completed, the platen is raised 4 in. and the jig car is indexed to the next panel.

More than a dozen push buttons and more than a dozen manual valves are assembled on a central operator's control board. Manually, these individual controls initiate any one of a dozen operations. The manual setting of a selector switch, however, will automatically execute a dozen operations as one. Duplicate panels may thus be spot welded with dispatch.

Magnetic control through a sequence panel is the brain or nerve center making possible the several functions in the execution of a panel cycle. The push buttons, selector switch, limit switches, contactors, and solenoids are interconnected with the entire machine set-up to obtain the following functions:

1 Permit manual control of each welding operation individually if desired.
2—Permit a set-up to be made which will then proceed automatically to the final pre-set point.
3—Permit any previously pre-set set-up to be interrupted if desired, a single operation performed and then continue the set-up.
4—Manual termination of any individual operation.

The set-up for panel welding of car roofs of a given design utilizes three transformers, five secondary switches, and 86 electrodes arranged in five groups—two groups of 19 electrodes each take the cross-line or car-line welds; two groups of 13 electrodes each at right angles take the sideplate welds; a fifth group of 12 electrodes, also at right angle to the first two groups, takes the purline welds between the carlines.

These 76 electrodes are attached to the spot-welder platen through pedestal mountings and shifting slides which permit 76 or 152 additional spot welds to be made by a 1-in. vertical lift of the platen and a 1-in. and 2-in. lateral movement of the various groups of electrodes, parallel to the mountings of the electrode groups.

The welding operations are electrically controlled to provide maximum speed and efficiency with a minimum of attention from the operator. The control provides and involves sequence of electrical interlocks between various parts of the machine. This interlock acts to start and terminate the movement of all associate machine parts in the proper order and to prevent the movement of any part of the machine when such movement would cause injury to the machine or materials being welded. In addition to regulating the mechanical motions of the machines, the control also serves to set up the proper circuit for welding and also times the application of welding current for each spot weld.

This equipment, through limit switches, relays and multi-point selector switch, provides automatic functioning on all operations as they are required.

The recent installation of multiple spot-welding equipment at our St. Charles, Mo., plant is adapted for the welding of passenger-car sides and roofs of alloy steel. The panel welding of passenger-car sides and roofs is accomplished on a single welder with certain changes, however, in the electrode set-up. A single welding jig car for sides and another for roofs is required. The set-up of electrodes for both the passenger-car sides and roof on the panel welder depends on the design, but is similar in all respects to the set-up for freight-car sides previously described.

YARD EMPLOYEES working on the night shift at the Canadian National's Leaside car shops, Toronto, Ont., put their training as fire fighters to good use recently, according to a Canadian National weekly news letter. Laying six lines of hose to avert fire threat from near-by oil and gasoline storage facilities and using a yard locomotive as a pumper, the employees worked side by side with Toronto city firemen in bringing the flames under control.

Locomotive

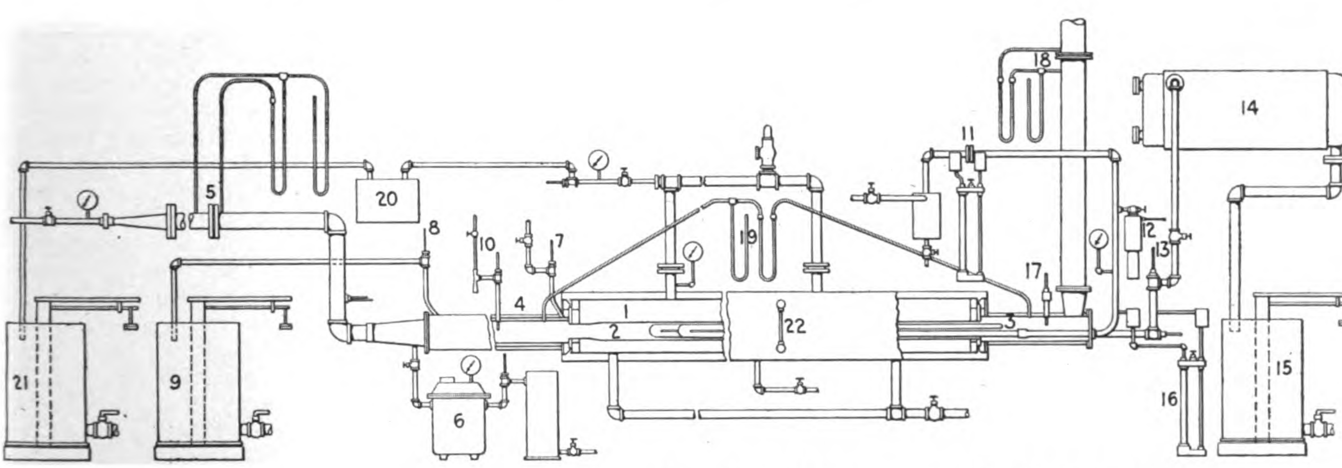
Superheater Research*

THE superheater is one of the most important parts of the steam locomotive. The superheater design determines the heating surface and gas area of the boiler barrel. These in turn influence the evaporation obtainable from the boiler and the efficiency of heat absorption. For a given boiler pressure, the steam pressure at the cylinders depends upon the pressure drop through the superheater units and header, and the temperature of the steam is the result of the heat absorbed by the superheater. These two factors, the steam temperature and pressure at the cylinders, control the steam rate or cylinder efficiency. From these considerations it is clear that the over-all performance of the steam locomotive is very closely controlled by the superheater design.

By Arthur Williams†

An account of a 10-year laboratory study of more than forty designs of units undertaken to improve the performance of locomotives built with Type A Superheaters—units of two designs now in locomotive service

The first practical superheater to be used in this country was of the design known as the Type A which is still in use on a great number of locomotives. With the increase in power and evaporation of the locomotive it was necessary to change the superheater design so that increased superheat could be obtained to give maximum cylinder efficiency and at the same time accommodate the increased steam flow through the superheater resulting from high rates of evaporation. The result was the Type E superheater, which still remains the best superheater design. Compared to the boiler and superheater with the Type A design, there is from 8 to 10 per cent increase in the total flue evaporative heating surface for the same length of flues, with 3 to 6 per cent increase in the gas area through the boiler and 35 to 50 per cent increase in superheater heating surface. At the same time it is possible to obtain an increase in steam area through the superheater. These factors give increased boiler efficiency, increase in maximum evaporation and higher superheat.



1—Boiler
2—Flue
3—Superheater unit
4—Water-cooled furnace
5—Air-flow meter
6—Fuel-gas meter
7—Furnace cooling-water temperature—Inlet
8—Furnace cooling-water temperature—Outlet
9—Furnace cooling-water weighing tank
10—Furnace gas temperature thermocouple
11—Steam flow meter
12—Calorimeter
13—Final steam temperature thermometer
14—Condenser for steam through unit
15—Weighing tank for steam through unit
16—Steam pressure drop manometer
17—Exit flue gas thermocouple
18—Flue gas flow meter
19—Draft manometers
20—Evaporated steam condenser
21—Evaporated steam weighing tank
22—Boiler gage glass

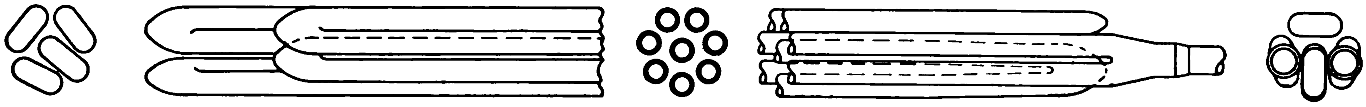
Fig. 1—General arrangement of test apparatus

Improving the Type A for Existing Locomotives

While the Type E superheater represents the best locomotive superheater design, The Superheater Company recognized that there were a great number of locomotives equipped with Type A superheaters in 5½-in. and 5⅜-in. flues. In 1930 a research program was started to study superheater design for use with these large flues. It was desired to find a unit which would be interchangeable with the Type A, would have approximately the same draft loss so that no changes in drafting would be necessary in an existing engine, and would give increased superheat, improvement in heat absorption efficiency of the flue and unit and the same or less pressure drop through the unit. Such a unit could be applied to existing locomotives with a minimum

* A paper presented before the Metropolitan Section, American Society of Mechanical Engineers, on February 26.

† Manager Production Engineering Department, The Superheater Company, East Chicago, Ind.



UNIT No. 1
Fig. 2

of expense and would give either decrease in fuel consumption or increase in power. From the practical standpoint the unit had to be sufficiently flexible in structure so that no trouble would be encountered with warping or with leaking header joints, and easy to keep clean from cinders and slag.

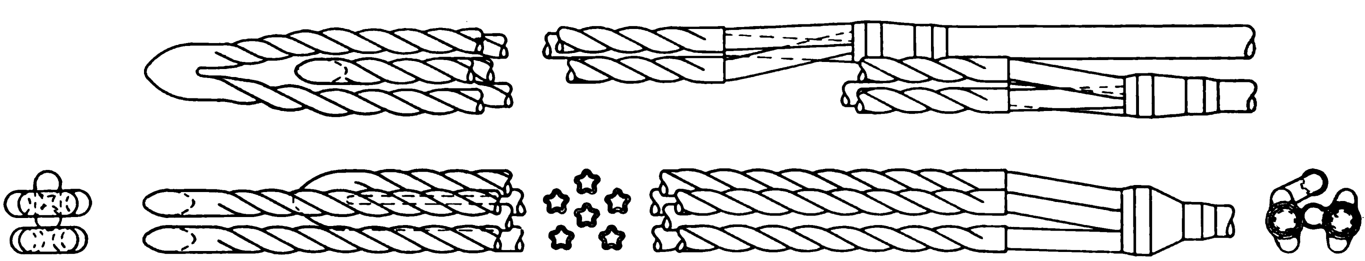
In determining the course which such research should take, attention was first given to existing data on the heat transfer from hot gases to a colder metal surface. Considerable work has been done on this subject and it is possible to calculate the film coefficient with fair accuracy. This coefficient depends upon the viscosity, conductivity, density and velocity of the gas in question, and the physical dimensions of the flue or tube in which the gas is flowing. The film coefficient will be in terms of B. t. u. per sq. ft. per hr. per deg. F. temperature difference, which gives the heat that will be transferred for each square foot of heating surface and for each degree difference in temperature between the mean gas temperature and the metal temperature.

It is this last item, the temperature difference, which makes the exact calculation of heat transfer for a locomotive flue and superheater unit extremely difficult. The gas temperature is rapidly changing along the flue and in the case of a Type A unit heat is being transferred simultaneously to five surfaces, all of which are at different temperatures. For a given superheater design, it is possible to use formulas with coefficients that have been determined by experiment. Considerable work along this line has been done by Lawford H. Fry and published in various papers and books. For the superheater research under consideration it was recognized that the various forms of units that could be tested might differ so widely from the Type A design that it would not be possible to use empirical coefficients. For these reasons it was decided to conduct the research by actual tests of a number of different superheater-unit designs.

To make such tests with full sets of superheater units in a locomotive was out of the question from the standpoints of time and expense, and in 1930 a test apparatus was built which could test one superheater unit at a time, under operating conditions similar to those obtained in road service, with exact control of all the factors involved. On a locomotive, the results obtained from the superheater depend upon the weight of products of combustion flowing through the superheater flues, the temperature of the products of combustion at the back tube sheet and the steam flow through each unit. The quality of the steam entering the superheater influences the final steam temperature but for purposes of comparison it can be assumed that the steam will be dry. A number of road tests were analyzed, and curves were drawn representing the relation between weight of gas flow, temperature at the back tube sheet and steam flow through the unit. From these curves sufficient settings were decided upon to give a picture of the superheater-unit performance over a wide range of capacity. By adjusting the three controlling factors in accordance with the actual road operation, it was felt that the results obtained in the test apparatus could be expected to be the same in road service. Subsequent tests confirmed this reasoning.

The Test Apparatus

The test apparatus is shown in Fig. 1. The boiler is 16 in. in diameter and 20 ft. long with one 5½-in. flue. A water-cooled furnace is fired with gas. Both the fuel gas and air for combustion are measured with flow meters. The sum of the two gives the total weight of products of combustion. The heat absorbed by the water-cooled furnace is calculated from the weight of water flowing and the temperature rise. The heat at the back tube sheet is the difference between the heat at the burner and the heat absorbed by the furnace. It was found that the most accurate way to determine the back tube-sheet temperature was to divide the heat in the gases by the product of the flue gas weight and specific heat. This gives the true mean gas temperature. This temperature is checked by an aspirating or high-velocity thermocouple. The steam for the superheater unit is taken from an outside source and the flow measured both by a flow meter and by condensing the steam and weighing it. The quality of the steam entering the unit is determined with a calorimeter and the final steam temperature with a thermometer which is checked by a thermocouple. The steam pressure drop through the unit is measured with a mercury manometer to obtain the greatest possible accuracy. The steam evaporated



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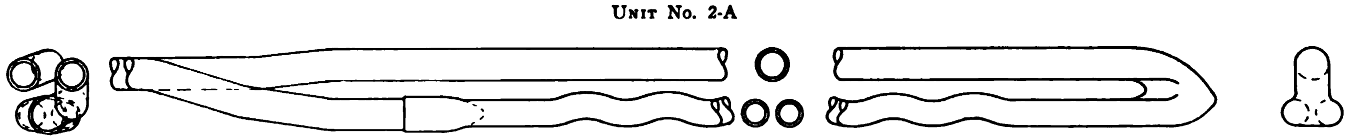
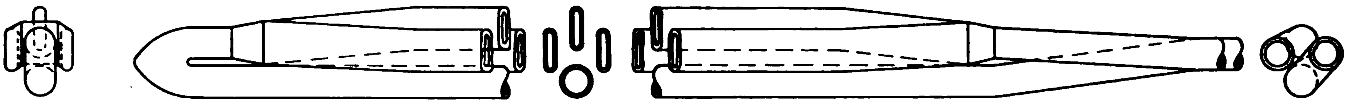
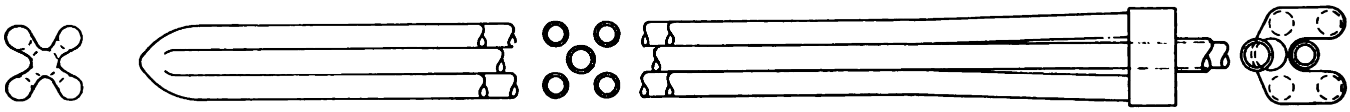


UNIT No. 2-B
Fig. 3



Unit No. 3-A



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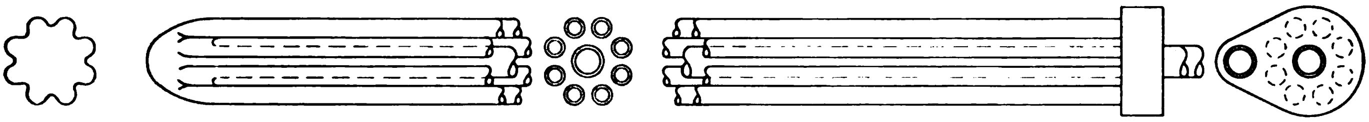


Unit No. 3-C

Fig. 4

by the flue is collected in vertical risers, condensed and weighed. The temperature of the gases leaving the flue is measured with a thermocouple and the draft loss through the flue with a water manometer.

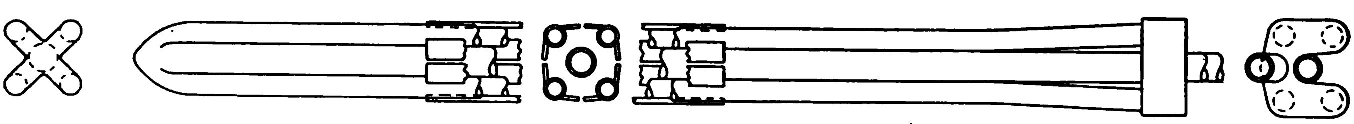
For given conditions of flue-gas flow, back tube-sheet temperature and steam flow through the unit, observations are made of the final steam temperature, temperature of the gases leaving the flue, draft loss, evaporation from the flue and steam-pressure drop through the unit. To eliminate all possible errors each unit is compared with a standard Type A unit. The Type A unit is first tested at the standard settings. The experimental unit is then tested and finally the Type A unit is put in the apparatus again for a final check to be sure that all parts of the test apparatus are functioning properly.

Test Units Divided in Five Groups

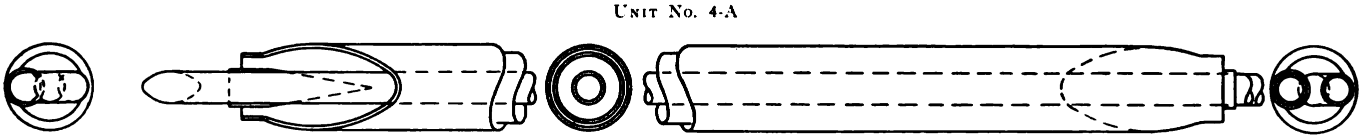
To date, 43 different designs of superheater units have been tested. The majority of this work was done in 1930 and 1931, although tests have been conducted up to date and the test apparatus is now a permanent part of The Superheater Company's facilities at East Chicago for further development of superheater design. To give a picture of the work done without going into detail for each one of the 43 designs, 13 of the units tested will be discussed, since they show various aspects of this research. These units are shown in Figs. 2 to 6, and can be divided into five groups. One of the first attempts to obtain increased superheat was to use a larger number of smaller pipes so that increased superheater heating surface was obtained with approximately the same gas area. This group is represented by Fig. 2, unit No. 1. A fair increase in superheat was obtained but the increased friction surface gave a decided increase in draft loss. If this unit were applied in a locomotive boiler the increased resistance to gas flow would cause a greater proportion of gas to flow through the small tubes and the increase in superheat desired would not be obtained.

In the second group, Fig. 3, units numbers 2-A and 2-B represent designs which give increased turbulence on both the outside and inside of the unit. Unit No. 2-A gave an increase in superheat that was offset by the increase in draft loss due to turbulence on the gas side. Unit No. 2-B was designed with a greater gas area so that the draft loss was satisfactory, but the superheat obtained was slightly less than for the Type A. In general, it can be stated that for a given draft loss or pressure drop the best heat transfer is obtained with plain tubing.

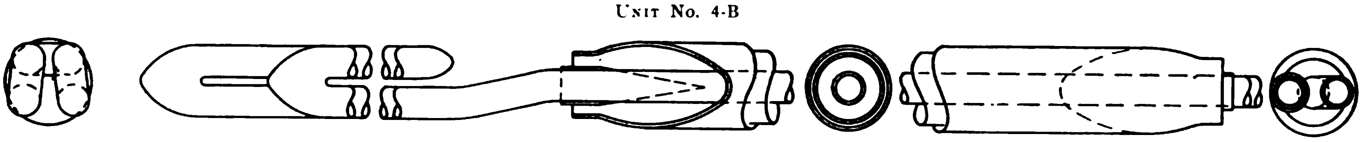
To obtain the maximum heat transfer for a given heating surface between a hot substance and a cold one it is usual to arrange the flows so that the two substances flow in opposite directions, giving counterflow. It is not practical to have 100 per cent counterflow in a locomotive superheater since the steam enters the superheater from the front end and also returns there. It is possible to have all of the heating surfaces in counterflow except for the return pipe and the third group of units, Fig. 4, shows three different designs which do this. Unit 3-A gave approximately the same superheat as the Type A with a decrease in draft loss. It seemed from this that it should be possible to increase the heating surface of the unit and so obtain the same draft loss with an



Unit No. 4-A

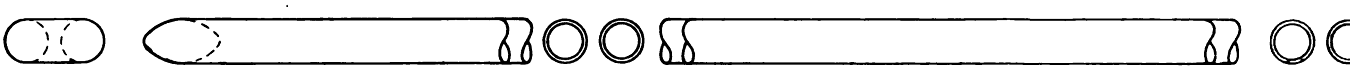


Unit No. 4-B

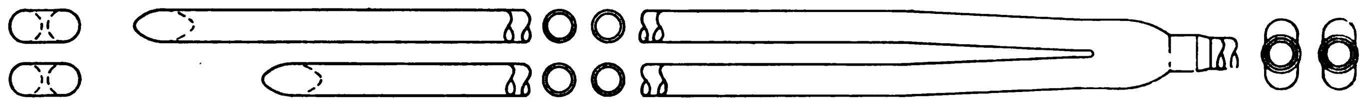


Unit No. 4-C

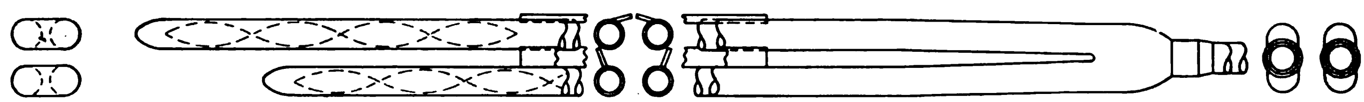
Fig. 5



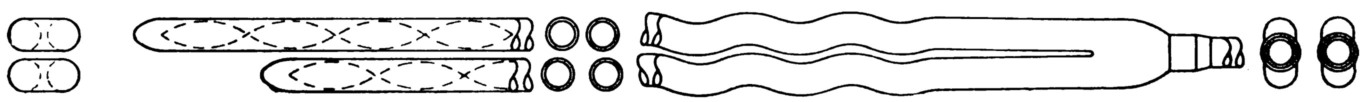
Unit No. 5-A



Unit No. 5-B



Unit No. 5-C



Unit No. 5-D

Fig. 6

increase in superheat. Unit 3-B was designed with this in mind but it was found that with the same draft loss as the Type A unit there was no appreciable increase in superheat. Unit 3-C went still further in this direction and a good increase in superheat was obtained but the increase in draft loss was sufficient to offset the increase in superheat.

The results obtained with these three units differed considerably from what would be expected with a counterflow arrangement. This was probably due to the complicated heat transfer conditions which occur in a locomotive flue. The counterflow arrangement of heating surface decreases the mean temperature on the steam side and increases the mean temperature on the gas side. The increase of the mean temperature of the flue gas increases the heat transfer to the flue. The result appears to be a slight increase in evaporation and efficiency of heat absorption but the desired increase in superheat is not obtained.

The fourth group of units, Fig. 5, includes three designs in which the relative amount of heat transferred to the flue and to the superheater unit is controlled. Unit No. 4-A had the same arrangement of pipes as unit No. 3-B. Somewhat smaller pipes were used for the counterflow surface and fins were welded on in such a way that the gas flow along the flue was divided into two parts. The gas flowing between the flue and the outside of the superheater unit could transmit heat to both, but the gas flowing along the inside of the unit could transmit heat only to the unit. As far as draft loss was concerned, the increased friction surface was compensated for by an increase in gas area, so that the draft loss obtained was the same as for the Type A. Approximately 50 deg. increase in superheat was obtained for the same conditions with a decrease in the temperature of the gases leaving the flue. This unit was very satisfactory in the test apparatus and was later tested in road service.

Unit 4-B also gave a controlled gas flow but in a different manner. The counterflow surface consisted of two pipes with the steam flowing in the annular space between them. The return was by a single pipe along the center of the unit. This unit gave satisfactory results as far as superheat and draft loss were concerned, but it was felt that it would not be practical for locomotive use. The unit was rigid and there was a possibility that the differential expansion between the two large pipes could cause some trouble at the ends of the unit. To overcome these defects unit 4-C was designed. The annular steam path with a large heating surface in counterflow to the gases was still maintained towards the front half of the flue where the low gas temperatures make counterflow desirable. The back end of the unit was made with four pipes and three return bends so that a flexible structure would be obtained, similar to the Type A unit which was known to be practical for all conditions of operation. At the back end of the unit, counterflow is not so essential due to the relatively high gas temperatures. This unit gave even better results than unit 4-B and was thought to be satisfactory for locomotive use. The results were about the same as for unit 4-A—that is, 50 deg. increase in superheat with a decrease in the temperature of the gases leaving the flue.

A Combination Counterflow and Double-Loop Unit in Regular Service

It was recognized that the test apparatus could furnish accurate figures with respect to the performance of the units as far as temperatures, drafts and pressures were concerned, but that the only way to judge the value of any unit from a practical standpoint was to put sets of units in actual locomotive service. Three sets of units to designs Nos. 4-A and 4-C were built and placed in

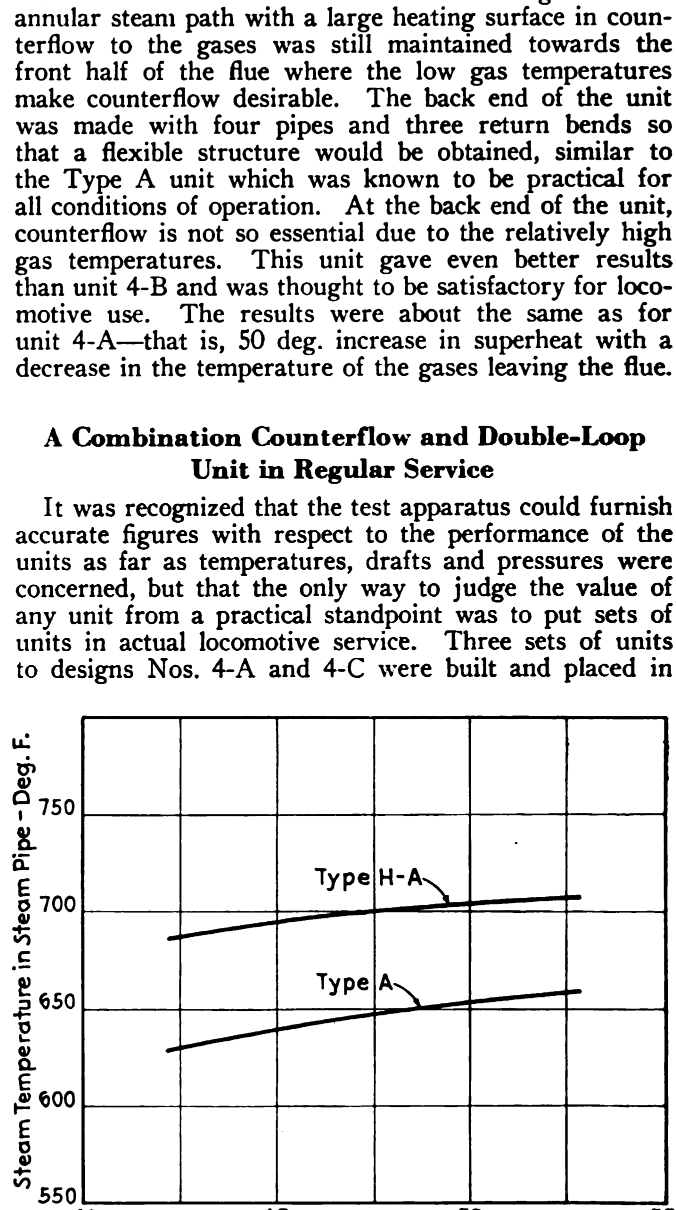


Fig. 7—Road tests of Type A and Type H-A units

service on three different railroads, thus obtaining varying conditions of fuel and locomotive operation. Trouble was encountered with the units to design No. 4-A due to the rigid structure of the unit. On one railroad it was difficult to keep the header joints tight, and on another road the header joints were tight, but the small pipes at the back end of the unit warped and split open. The results obtained with unit to design 4-C were very satisfactory and this design is now known as the Type HA unit. Approximately 200 sets are now in service and on order. Fig. 7 shows the results obtained on one railroad with the Type HA unit. The locomotive was first tested with the Type A units in the engine. The Type HA units were then substituted and further tests run over the same territory, duplicating as far as possible the same operating conditions. It will be noticed that the increase in superheat was approximately the same as that obtained in the test apparatus at East Chicago, confirming the accuracy of the method of testing.

In the discussion on a recent paper presented before the A. S. M. E. by C. A. Brandt, "The Locomotive Boiler,"* it was pointed out that a number of engines are being worked at much higher rates of evaporation than formerly, due to faster schedules and heavier trains. If the original superheater design had a small number of units, the pressure drop through the superheater becomes high for maximum rates of working. It is possible to obtain a marked reduction in the pressure drop through the units by using a single-loop design. Such a design will decrease the steam velocity and consequently the pressure drop. The decrease in steam velocity will also lower the heat transfer coefficient on the steam side so that there may be a slight decrease in superheat and an increase in the superheater unit metal temperature at the back end.

A Practicable Single-Loop Unit Evolved

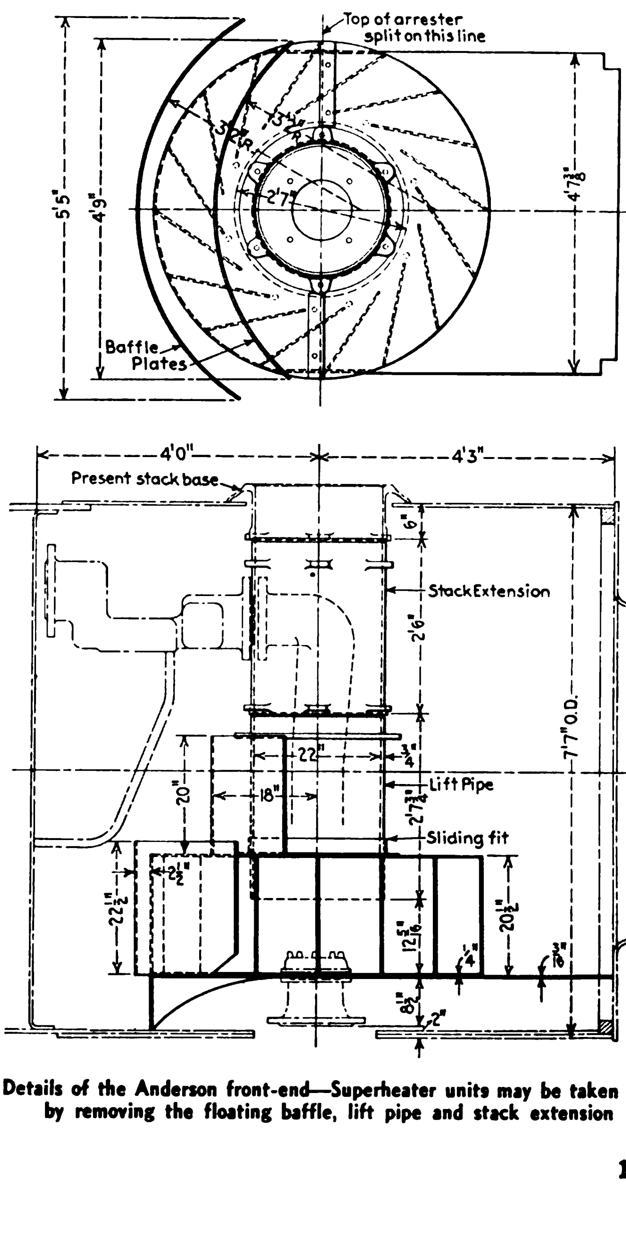
The simplest form of such a unit is shown by design No. 5-A, Fig. 6. When this unit was tested, the pressure drop was found to be very low but there was a decrease in both superheat and draft loss with an increase in the temperature of the gases leaving the flue. Evidently, there was not sufficient heating surface for proper design. Unit No. 5-B was an improvement in this respect and gave a very low pressure drop with the same draft loss as the Type A and a very slight decrease in superheat. To obtain an increase in superheat, unit No. 5-C was designed with fins welded to the pipes. The increase in superheat was obtained but there was also some increase in draft loss which would tend to offset the increase in superheat. This unit had spiral agitators for a short distance at the back end of the unit to give the steam greater turbulence and keep the metal temperatures down. The desired result was obtained with no appreciable increase in pressure drop. Apparently the length of the agitators was not sufficient to cause any great difference in the pressure drop.

Several railroads have installed single-loop superheaters in locomotives and have had considerable trouble with leaking header joints and warping of units due to the differential expansion of the unit pipes and the relatively stiff structure of the unit. Unit No. 5-B was designed for the particular purpose of overcoming these troubles. The pipes were waved for the greater part of their length to give a flexible structure that could absorb the differential expansion. At the same time the maximum flexibility was obtained in the connections between the units and the header. This unit also had the spiral agitators at the back end to control the metal temperatures. The results obtained in the test apparatus were similar to those for unit 5-B, giving a low pressure drop and approximately the same superheat and draft loss as the Type A. One set of these units has been placed in service and is proving very satisfactory with respect to troubles from header-joint leaks and warping of the units.

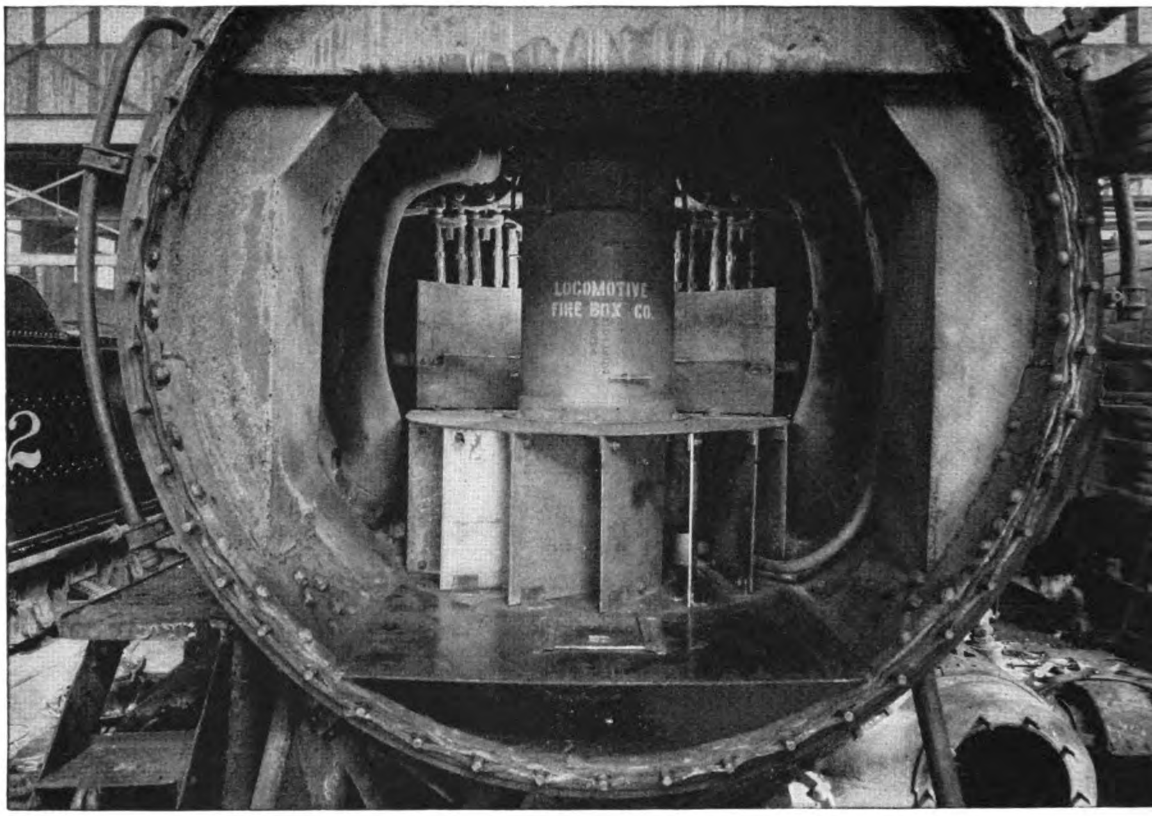
* See February and March, 1940, issues *Railway Mechanical Engineer*, pages 43 and 100 respectively.

The Anderson Front End

The Anderson locomotive front end was developed and successfully applied to about 150 locomotives on the Chicago, Milwaukee, St. Paul & Pacific, as described in the January, 1939, *Railway Mechanical Engineer*. Manufacturing and sales rights for this device were acquired by the Locomotive Firebox Company, Chicago, about two years ago and further improvements and developments made to adapt the new front end design to general use on railroads throughout the country. The spark arresting unit, itself, is practically unchanged from the original design, but a number of important revisions in other details tend to simplify the construction and installation of the device, lengthen its service life, increase



Details of the Anderson front-end—Superheater units may be taken out by removing the floating baffle, lift pipe and stack extension



General arrangement and method of application of improved Anderson spark-arrester—Baffles behind and above the arrester are the only obstructions to the direct flow of gases—The space under the false floor is closed at the rear

drafting efficiency and reduce materially the time and cost of all front-end maintenance work.

In early and extensive tests of the Anderson locomotive front end on the Milwaukee, it was demonstrated that this device would eliminate stack sparks and the attendant fire hazard, but, in making the application, the vertical baffle and horizontal table plates were still used with the relatively high nozzle stand, compelling all gases and cinders to take the usual paths as in the Master Mechanic's arrangement.

Netting had been eliminated, but the restrictions set up by the tortuous paths of the gases and cinders around the baffle and table plates still produced a marked reduction in the draft at the front tube sheet. In order to reduce the loss in draft and to provide a uniform draft over the entire tube sheet, the vertical baffle plate and horizontal table plates were removed. A low nozzle stand was applied and the arrester dropped down to the top of the low stand. With these changes, the stack extension was lengthened. A false floor was placed in the bottom of the smokebox to prevent the accumulation of cinders. Vertical floating baffles were installed behind and above the arrester, acting as cinder breakers, but without materially interfering with the draft.

The application of the low nozzle and lengthened stack, which heretofore has been impracticable on account of the necessity of handling all gases and cinders underneath the table plate, effects a direct improvement in draft with the same back pressure. The increase in stack height and improvement in draft conditions at the tube sheet make it possible to operate a locomotive with an enlarged nozzle tip and reduced back pressure at comparable rates of evaporation. On the other hand, if it is desired to increase the total evaporation, which may necessitate an increased coal rate, this increase can be obtained without reducing the nozzle tip to create more draft. In either case, it is claimed that a direct improvement is effected by the use of the Anderson front end as a draft appliance as well as a spark eliminator. The equalization of draft over the entire tube sheet and throughout the entire smokebox also tends to cause a reduction of cinder cutting, especially in the smokebox.

The changes mentioned were devised primarily to improve the Anderson front end as a draft appliance, but after being made, it developed that the changes greatly facilitated the installation of the front end and other maintenance work in the smokebox. The elimination of vertical baffle and horizontal table plates, together with the simplicity of the arrester unit, makes it possible to apply the arrester in a short time. With the cinder breakers made and the false bottom in the smokebox, it is relatively easy to apply the arrester, lift pipe, and stack extension.

The halftone illustration shows that, in testing superheater units, no plates have to be removed to see all of the joints in the header. All that is required is to remove two vanes in the arrester, block the nozzle, and then apply the pressure. It is not even necessary to get into the smokebox to see if the units are leaking. When all of the units have to be taken out, this can be done quickly and cheaply by removing the floating baffle, lowering the lift pipe so that the stack extension can be removed, then raising the lift pipe and removing it after the stack extension is out of the way. All of the units can then be taken out over the top of the arrester.

Experience indicates that locomotives can be turned in an eight-hour period for superheater-unit repairs when equipped with this type of front end. Units on each side of the lift pipe can be removed by simply dropping the cinder breaker without disturbing any other part of the smoke box. It is possible to apply the Anderson front end where feedwater heaters are installed without making any additional changes in the smokebox. The details of the front end are shown in the drawing.

EDITORIALS

A New Field for Steam-Locomotive Development

That the possibilities for the extension of the capacity of the steam locomotive at high speeds have not been exhausted will be clearly evident to all who read the article on another page of this issue which is an account of the tests of locomotive No. 5399 on the Pennsylvania test plant at Altoona, Pa. As in the road tests, the results of which were reported in the April issue, the performance of locomotive No. 5399, equipped with the Franklin system of steam distribution with O. C. poppet valves and in which had been installed a new superheater header with new single-pass Type A units, is compared with the test-plant performance of a standard Pacific type locomotive of the same class.

The basic design of this locomotive was laid down at a time when the extreme top speeds at which steam passenger locomotives were expected to operate were no higher than today's cruising speeds. It is not surprising, therefore, to find these locomotives deficient in capacity at the top speeds at which passenger trains now frequently operate. The really surprising fact is that so large a capacity as that developed in these tests was inherent in the basic design of these locomotives. Certainly, a locomotive with a boiler which develops an evaporating capacity of almost 21 lb. of steam per sq. ft. of evaporative heating surface per hour, which produces an indicated horsepower for slightly less than 80 lb. and, what is even more remarkable, a drawbar horsepower for less than 87 lb. of engine weight, is holding its own in the matter of capacity with the best proportioned locomotives in service today.

Such performance is the result of the removal of the restrictions on the flow of steam to the cylinders and the discharge of the exhaust from the cylinders. The restriction of first importance was in the valves. This was demonstrated in the road test described in last month's issue. Important further gains where the result of the subsequent changes in the steam passages between the boiler and the steam chest, which effected marked decreases in steam-chest pressure drop with consequent improvements in mean effective pressure.

The results of these tests confirm the conclusions reached by André Chapelon as to the importance of unrestricted passages for the flow of steam between the boiler and the cylinders. M. Chapelon employed poppet valves and steam passages doubled in cross-sectional area in the rebuilt Paris-Orleans locomotive and they were important factors in increasing the capacity of that locomotive from 2,200 to 3,700 i. hp. with an increase in weight of 11 tons.

Among the outstanding factors in the performance of locomotive No. 5399 on the test plant is the very low friction loss. From 85 per cent at the lowest tractive forces the machine efficiency rises rapidly and throughout the greater part of the range of tractive forces developed on the test plant lies between 90 and 95 per cent. Attention should be called to the fact, however, that the friction losses measured on the test plant include nothing for engine-truck, trailer-truck, and tender-truck journal friction, nor is there any head-end loss. These facts must be taken into consideration in comparing the test-plant figures with losses between the cylinders and drawbar measured in road tests.

The results of these tests open an era in which poppet valves and adequate cross-sectional area through the entire chain of passages from boiler to exhaust nozzle provide the means for developing great locomotive capacity within conservative limits of size and weight.

Oranges and Car Wheels!

Almost every one has, at one time or another, watched the operation of squeezing oranges in one of the several ingenious mechanical contraptions now used for this purpose in restaurants and homes, but how many recognize the law of diminishing returns so clearly exemplified in this homely illustration. The first partial turn of the handle produces a golden flood of the health-giving juice. The second application of pressure produces a less generous response, the third still less and subsequent efforts practically none. Unquestionably, a few drops of entirely nutritious and highly-desirable juice are left in the discarded orange pulp, but the time and work involved in reclaiming them would be all out of proportion to the benefit derived.

Similarly with freight car wheels, is it not possible that strenuous efforts to secure the last possible mile of service life before scrapping may cost more in the aggregate than that service is worth. In a recent discussion of this matter by a group of practical car men, the thought was expressed that partly worn cast iron wheels should be renewed when the cars are in the shop for repairs even if the wheels have not quite reached the condemning limit for wear. In justification of this practice, it should be recalled that the Association of American Railroads' price for a pair of 50-ton capacity new cast-iron car wheels, exclusive of the axle, is \$31, and if the average life of cast-iron wheels is assumed to be 80 months, the service value per month is 39 cents. In the case of partly worn wheels which might possibly remain in service for another five

months before reaching the wear limit, the scrapping of these wheels at the time other car repairs are made would mean the loss of five times 39 cents, or $1.95. On the credit side of this transaction, however, must be charged the saving in cost of a possible train delay, switching the car with limit-worn wheels out of the train, hauling the car to and from the repair track, and losing several days service of the car because of having to renew the wheels five months after the car has been turned off the repair track.

Since the detentions of loaded cars enroute are caused primarily by defective wheel conditions, and in view of the ever-increasing urge for more reliable service in modern high-speed operation, it would appear to be false economy to endeavor to "squeeze the orange" of wheel service life too tightly. The indications are that it is better practice and money will be saved in the long run by changing wheels with less than four to five months of prospective service life whenever system-owned cars are on the repair track for other work.

Standardization—Of Errors

During these past 10 years attention has constantly been drawn to the fact that the time to prepare for war is in time of peace and that the time to prepare for the day when increased traffic on the railroads would require better maintenance facilities was during the time when the pressure of business was light enough that carefully prepared plans could be made for the completion of a program of rehabilitation of facilities as soon as capital was available. A few of the more far-sighted roads made such plans and have been making the necessary purchases to bring their facilities up to the requisite standard for some time in the past. This is not only true of motive power and rolling stock but is also true of shop and enginehouse facilities. One eastern railroad is now well along on a program involving the expenditure of approximately a million dollars for machine tools and shop equipment alone. This road, among others, will probably be in a position to cash in on any improvement in traffic by lower operating expenses as a result of the use of modernized facilities.

Times such as these do peculiar things to the thinking processes of people. There seem to be those who have been so overcome by the "terrible urgency" of the present situation that they have focused their attention on production as the main objective, "get it any way you can." Far be it from this publication to suggest that every effort, in every industry that is essential to national defense, should not be devoted to increasing the production of those things that are vital to our national welfare. But, when a railroad man sends us a story telling how, in the demand for production, his company has permitted, yes, we might say authorized, the expenditure of real money for the rehabilitation of machine tools that are 30 and 40 years old that's where we stop. The justification for spending money to put obsolete machine tools into service again is that the railroad industry can't get new ones "for love or money." Would it be out of order to ask the question, "Why not?"

Back in 1935 an important railroad spent $227,000 for new machine tools. In the normal course of events, this road probably would be pretty well satisfied to have this equipment pay for itself in 10 years. These tools were installed and in operation in 1936 and within one year had indicated a reduction of well over 20 per cent in the cost of locomotive repairs. For the years 1936, 1937 and 1938 the shop in which they were installed operated at only 30 to 50 per cent of its capacity—this is potential shop hours of about 2,500 a year. In 1939 and 1940 things began to pick up and now in 1941 the shop is running at 100 per cent capacity on the first shift plus a substantial amount of second-shift work. On March 31, 1941, the savings effected by these machine tools was 76.4 per cent of the original investment. So much for the value of modern machine tools.

Today, in order for an industry to get machine tools it has to have a preference rating based on the importance of the work it is doing. Early this year the executives of every railroad that is a member of the Association of American Railroads received a letter from the Association's president transmitting copies of applications for preference rating together with instructions for making such application. It is evident, from some conversations we have heard lately that there are railroad men who still do not know that the railroads are considered an essential industry and that if they fight hard enough to get a preference rating for facilities and tools that are needed for the proper maintenance of equipment necessary for the transportation of materials to be used in connection with national defense they probably will succeed just about as well as the other important industries. It is also well to remember that there are certain types and sizes of machine tools and shop equipment that are easier to get than others and it is possible that some of these types and sizes are in the category needed most by the railroads.

We repeat again that any railroad officer that authorizes the expenditure of money for the maintenance or rehabilitation of obsolete machine tools or shop equipment is throwing his company's money away because he is perpetuating—standardizing, possibly—an error that has been made many times over. A day's labor at 83 cents an hour costs a railroad $6.64 and if this labor is expended on a machine tool that can produce only 10 pieces a day instead of 20 or 30 pieces the answer is obvious.

Don't standardize errors—and don't assume that you can't get needed new facilities until every effort has been exhausted.

Periodic Repairs To Freight Cars

There is probably no surer method of securing increased efficiency and greater economy in car-department operation than by the periodic attention to freight cars and the scheduling of repairs on an orderly basis at regular fixed intervals instead of relying on antiquated hit-and-miss methods. Periodic general-repair programs have been developed on many railroads for locomotives and passenger cars and this method apparently is almost equally adaptable to freight equipment. The best overall results will not be attained, however, until light repair work on freight cars also is systematized so as to keep both new and older cars in safe and serviceable condition at minimum cost.

The Chicago, Milwaukee, St. Paul & Pacific was one of the first railroads to recognize the possible economies in periodic freight car maintenance and has, in fact, been following such a program for the past 12 years. It cannot be questioned that this program is responsible to no small extent for the following results, as outlined by F. A. Shoulty, assistant superintendent car department, in a paper at the February 18 meeting of the Car Department Association of St. Louis: Average cost of repairs per freight-car mile decreased about 20 per cent; number of times cars were on repair track decreased 16 per cent; accidents due to equipment failures decreased 70 per cent; freight claims due to defective equipment decreased 40 per cent; safety-appliance defects reported by I. C. C. inspectors decreased 25 per cent; purchases of couplers, friction draft gears and parts, decreased 32 per cent.

The Milwaukee freight-car maintenance program provides essentially for giving general repairs to system-owned cars at four-year intervals and this is made possible by setting up a proper retirement program and repairing equipment on a predetermined ratio of car-repair cost to gross railroad revenue. To systematize light repair work, it was felt that some intermediate period of time between heavy repairs should be fixed whereby freight cars would receive a thorough inspection and what might be termed a minor overhauling and this should take place when the cars are placed on repair tracks for the periodic repacking of journal boxes, or in other words, every 12 to 15 months. This work is now being done at nine of the larger repair tracks on the Milwaukee which have the necessary forces and equipment.

According to Mr. Shoulty, "The annual inspection consists of a close examination of all safety appliances, roofs, running boards, hand brake in all its details, doors and door fixtures, interiors of the cars, couplers and attachments including draft gears, brake beams, brake-beam safety supports, foundation brake gear, wheels, axles, spring planks, truck springs and truck sides, especially on the wheel side and in other places which would be apt to be overlooked in the hurried inspection at busy transportation yards."

Work indicated as necessary by the critical inspection described is carefully performed and this annual attention, in conjunction with the four-year general repair program, has a tendency to keep cars off the repair track and assure maximum earning capacity during the ensuing year. The main idea is to give freight car equipment periodic attention without waiting for individual cars to become so deteriorated that they cannot be depended upon to carry commodity loads to destination safely and without delays due to equipment failures. Performance records indicate that the thorough periodic maintenance of freight cars, carried out by some systematic method such as that now used on the Milwaukee, produces highly desirable results in reduced car costs and improved performance.

New Books

Proceedings Association of American Railroads, Mechanical Division. *Published by the association, 59 E. Van Buren street, Chicago. 508 pages. Price, to member, $4; to non-members, $8.*

The proceedings of the annual meeting held in Chicago June 27 and 28, 1940, contain the reports of committees and discussion presented at that meeting, and the recommendations of committees submitted to letter ballot of the members by authority of the General Committee. The volume also includes a summary of the report of the New York Central draft-gear recoil tests which were presented with the report of the Committee on Couplers and Draft Gears and a report on intercrystalline cracks in locomotive boilers which is based on an investigation of this subject supported jointly by the Association of American Railroads, the American Society of Mechanical Engineers, the American Society for Testing Materials, the American Boiler Manufacturers' Association, and a number of other associations and interested groups. Recorded also are the results of the letter ballots taken on the recommendations of the various committees; the officers of the association; the personnel of the various committees of the Mechanical Division, and the representatives at the 1940 meeting.

THE READER'S PAGE

Thirty-Five Years of Poppet-Valve Experience

To the Editor:

On page 17 of your January, 1941, issue, L. B. Jones charges American locomotive designers with "deep-rooted conservatism" because they continue to build two-cylinder locomotives with one-piece reciprocating valves, though he also retains the two-cylinder arrangement for his improved locomotive *E*. American experience with both simple and compound multi-cylindered non-articulated engines is recent enough to obviate any necessity for a defense of the two-cylinder locomotive.

The piston valve also retains its place because nothing better is at present available. I say this in the face of Mr. Jones' statement that valve arrangements which meet the requirements for proper steam distribution more or less perfectly are extensively used in Europe. It is assumed that he refers to poppet valve gears. If so, they are most numerous in France, where 335 locomotives were equipped as of April, 1940, according to official statistics. I do not imagine that many have been added since then. Three hundred and thirty-five locomotives is a considerable number, but it does not imply that the French have reached a final, or even a satisfactory solution of the steam distribution problem. There are, in fact, at least half a dozen radically different poppet valve systems in use on French locomotives. The French are not agreed on either the size and shape of valves or their proper position, nor do they agree on the most suitable means of driving the camshafts. Much remains to be done before any "more or less perfect" system emerges from the present large-scale experimenting. Mr. Jones might also be interested to know that it was intended to apply piston valves to a group of fifty 2-8-2 type four-cylinder compound freight locomotives under construction for the French National Railways at the time of the German invasion.

The history of the steam locomotive contains countless examples of "improved" valves and valve gears. Attempts to eliminate the much-maligned reciprocating valve have not been lacking. More than 80 years ago, George H. Corliss applied his well-known stationary-engine valve gear to a locomotive. One of Corliss's contemporaries remarked somewhat facetiously that the engine actually needed 365 valves because one had to be renewed every day in the year. This early failure did not discourage later experimenters. Between 1885 and 1898, some 50-odd French locomotives were fitted with various valve mechanisms more or less resembling the Corliss gear. They have all disappeared long since. C. W. Young's Corliss valve gear of 1904 may still be remembered on the Chicago and Northwestern.

The successful use of drop-valves and poppet valves in stationary and internal-combustion engines was drawn to the attention of locomotive designers as early as 1900. Hugo Lentz was perhaps the best known pioneer in the application of poppet valves to steam locomotives. Beginning with a small 2-4-0 type industrial tank engine in 1905, the Lentz poppet valves were tried on locomotives of assorted types and sizes in nearly every country of Europe. The older form, employing vertical valves, achieved its greatest success in the Grand Duchy of Oldenburg. Between 1909 and 1921, 48 engines with Lentz poppet valves were built for the Oldenburg State Railways. When these lines were taken over by the Reichsbahn in 1922, the engines were very shortly "mustered out" of service.

In 1920, Lentz redesigned his poppet valve arrangement, placing the valves in a horizontal plane, but still driving them from an oscillating camshaft actuated by ordinary Walschaerts valve gear. More than 300 locomotives of the Austrian State Railways were subsequently equipped with this form. Now that the Austrian railways have become part of the Reichsbahn, these engines will undoubtedly be disposed of, as they do not fit into the German standardization scheme and poppet valves have never enjoyed great favor in Germany.

Improved Lentz poppet valves, operated by either oscillating or rotary camshafts and driven by various methods, have been applied in considerable numbers in many countries since 1921. But it is not possible to detect any widespread enthusiasm for them. After using Lentz rotary-cam poppet valves on about 150 large 4-6-2, 4-8-2 and 2-10-2 type narrow-gauge engines of typical American design, the South African Railways have returned to the piston valve in all their most recent orders for new power. Several of the larger railways in British India have also reverted to the use of piston valves after extensive trials of both Lentz and Caprotti poppet valves. About 50 English engines were equipped with Lentz valves up to 1934, when the pace of the experiments appears to have slowed up abruptly. Lentz valves have been applied to at least three American engines since 1925.

Arturo Caprotti's well known poppet valve gear first appeared in Italy in 1921. By 1928, it had run its course in that country. Caprotti's gear has, however, obtained a certain degree of popularity in other parts of the world. It has been largely used in Egypt and India, among other places, but has made slow progress in recent years. A set of this gear was brought to the United States by the Baltimore & Ohio about 15 years ago.

Other poppet valve gears have been devised elsewhere in Europe, notably by Cossart and Renaud in France, and by Meier Mattern in Holland. Extravagant claims, mostly unrealized in practice, were made for all of them.

The theoretical advantages of the poppet valve operated by rotary gearings are too obvious to require extended comment. Are the practical disadvantages and difficulties insurmountable? The long list of purely transitory successes might almost convince one that they are, if it were not for the feeling that much experimental work in the past has been desultory and half-hearted. No new device can be perfected by introducing it with a great fanfare of publicity and then throwing up one's hands in despair when the first troubles present themselves. The knowledge gained from 35 years of experience with 1,500 locomotives, coupled with a whole-hearted determination to translate the potentialities of the poppet valve into actual practice, can furnish a solid basis for progress in the future.

Wm. T. Hoecker.

Suggestions for Mechanical Associations

Get the Younger Men Out

Cannot something be done to get more of the younger men to attend and take part in the conventions? For a number of years during the depression few young men were recruited. It is true that special attention has been given to this during the past two or three years. It is also true that some comparatively young men have been advanced to minor supervisory positions and a number of others are on the various staffs related to important special duties. These young men have ideas and know how to express themselves effectively.

Their attendance and participation in the conventions would undoubtedly do much to stimulate the discussion and thinking, if they were properly encouraged. Would it not be well to have a committee or some individual in each association assigned the task of getting as many of these young men as possible to the conventions and seeing that they are made use of when they do get there?

C. D. O. A. and Contaminated Cars

There was an interesting discussion at the last meeting of the Car Department Officers' Association in the matter of loading contaminated commodities in freight cars. When you receive the proceedings please note the approach to definite action taken and the possibility of really taking that action next year. This question is so important from the standpoint of expense and shipper dissatisfaction that you could well play on this, to the end that the various departments interested will secure enough backing from the different associations to permit establishing the changes in practice necessary to eliminate this wasteful use of cars. The claim men got behind this strongly several years ago, when a number of horses were poisoned by oats fed to them after moving in a box car, which had carried a previous load of arsenic and had not been properly cleaned.

Financial Support Necessary

Those of us who are fighting to rebuild the mechanical associations have no easy task, even though we have made a fairly good record in the past two years. We were forced to discontinue our meetings during the depression years. This "shot" our membership and our administrative group all to pieces. It takes something more than time and patience on the part of a few good, highly interested souls to carry on an organization. It takes money to prepare and distribute reports and money to publish proceedings. To get this money we must have membership dues. If we can get sufficient members we can do quite well with modest dues, almost nominal, in fact. The problem is to get the members. You folks on the *Railway Mechanical Engineer* have blazoned forth the value of the associations. You have turned your columns over for practical suggestions on how to make the work of the associations more effective. Won't you please urge mechanical department officers to put their shoulders to the wheel and do their little part by joining up and sending in their dues?

Snappy Meetings

I got a bit disgusted last year because some of the sessions were not started on time; in other instances the presiding officer was rather careless and lax in keeping the program moving along in a business-like way. I realize, of course, that we are not all born presiding officers; as a matter of fact, few of us have had much experience or know just how to conduct a meeting. I have learned from embarrassing experiences that you just can't get up at the presiding officer's desk and expect to make good without a considerable amount of forethought and planning. In other words, you have got to be prepared to meet difficult situations and to take the bull by the horns to keep the meeting running smoothly. Don't mistake me, however. It may be quite necessary to pause at times, to give those present time to collect their wits and indicate that they want to speak. It doesn't do to get nervous and pass on to another subject, or adjourn a meeting in a rush, because people don't jump to their feet and take part in the discussion. Sometimes an awkward pause is necessary to smoke them out, but when they once get started your troubles are usually at an end. Moreover, you can do this sort of thing in such a way as to keep the meeting well in control. Please insist, also, on quietness and order at all times. A few careless spirits moving about, or trying to whisper with husky voices, may spoil the meeting for many of the members and prevent it from being as effective as it might be. It sometimes takes a little nerve to make the boys maintain order, but that is the presiding officer's job.

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Comments from readers on suggestions made in our November, 1940, number for making more effective the efforts of the Mechanical Department Associations. ***See also January number, page 25; February, page 70; March, page 109, and April, page 144.***

Everybody Push!

Fundamentally, good committee reports form the basis for successful conventions. It is conceivable that without them a meeting might appear to be a success on the surface, if some live topical discussions could be staged. Quite likely, however, it will lack in real substance and may have only indifferent results, so far as practical accomplishment is concerned. What does this imply at this particular juncture, less than five months before the meetings will convene in Chicago, late in September? It means that every member of the four associations has some very specific responsibilities. The officers, entrusted with leadership responsibilities, must check up and use their individual efforts to the limit in following up the work of the various committees. The committee chairmen are on a particularly hot spot, for to be most effective their reports must be completed and be in the hands of the officers within a few weeks, at most. The committee members, if they have not yet done so, should send their material to the chairman and complete such assignments as have been made to them. Oh, yes! They may plead heavy business and all that sort of thing, but from the standpoint of better and more efficient railroad operation and to meet national defense demands, successful meetings next fall may play a very large part. The members of the associations who have no special assignments, cannot duck responsibility. They should look over their programs and contact with any of the committees to which they can supply helpful information or suggestions. Moreover every committee member should be busy boosting his association and helping increase the membership. Now is the time for every one to roll up his sleeves and push.

Reporting Back to the Boss

I do not think it is at all a bad idea for a man who has attended a convention to write a letter to his superior, thanking him for the opportunity of attending, or about something he may have seen or heard, which either interested or inspired him. Any real value which men may get from meetings of and contacts at a convention is, however, something more fundamental than that. A good idea is one with meat on it—something which has to be digested and chewed over—something which can be turned over and mulled until eventually it gives up its value in the sinews of action. If a man gets inspiration to try out something new or radical at a convention, as a result of anything which may have stimulated him in any session, it is not apt to be "jelled down" to a full-fledged plan of action, ready to put on paper for a report to the boss next week.

H. H. Carter, master mechanic of the Plains Division of the S. P. & W., made a few choice remarks that blistered the paint on the office wall

WHEN THE SCRAP HEAP YAWNS

by **Walt Wyre**

WHEN the federal inspector slapped a Form 5 on the 5097, H. H. Carter, master mechanic of the Plains Division of the S. P. & W., made a few choice remarks that blistered the paint on the office wall. Jim Evans, the roundhouse foreman, has a hide that is almost puncture proof and Carter's vituperation stung the foreman.

"And to make matters worse," Carter continued, "the 5097 has just been off the drop-pit a little more than three weeks. If them mail order mechanics you've got can't do better work than that, there's likely to be some new faces around here!"

"The mechanics we have are all right," Evans defended. "They are good as you'll find anywhere."

"Then why"—Carter started to pound the desk and remembered his fist was already sore—"then why is it an engine right off the drop-pit gets a Form 5 on account of driving boxes pounding?"

"There are several reasons," Evans explained, "but the main reason is the driving boxes were all out of round and new brasses can't last long when they just fit the driving boxes in spots. I mentioned that when I asked for a slotter over a year ago."

Carter having blown off all of his surplus steam was ready to reason. He scratched his head thoughtfully,

then said in a milder tone, "You know a Form 5 is hard to explain but maybe we can make it somehow. You know they are dismantling the back-shop at Clinton, don't you?" he added.

"Yes, I'd heard they were going to."

"Well, there's little or no chance of getting any new machine tools now, but maybe there's a chance of getting some there. I believe they have a slotter," Carter said.

"Wonder if they have an 18-inch lathe we might get?" Evans asked.

"Well, I'll find out," Carter said and picked up a letter indicating that the interview was over.

The foreman picked up his hat and started back to the roundhouse. He stopped at the storeroom. "How about the material for the feed-water pump on the 5092?" Evans asked the storekeeper.

"Not yet," the storekeeper replied. "The defense program is making all kinds of material mighty slow."

"Guess that's as good excuse as any," Evans said dryly as he turned to go.

The foreman walked through the roundhouse pausing at intervals to check up on engines and figure when they could be ready to go.

Evans stopped at the 5093 and stood a minute or two watching a machinist and helper that were busily engaged holding up one side of the locomotive by leaning against it.

"We're waiting for a back end main rod brass," the machinist explained; then said to his helper, "Maybe it's finished now."

"How much more have you got on her?" Evans asked.

"A middle connection bushing on the other side is all except a bushing for this main rod," the machinist replied.

Evans went to the machine shop to see if he couldn't uncork the bottleneck, but there was very little he could do about it. The bushing for the main rod was finished and in the tool room waiting to have grease holes drilled in it. The drill press operator was down on his hands and knees scanning the floor.

"Lost something?" Evans asked.

"Yes, the balls came out of that upper bearing and scattered all over the place. I've found all but three of them. They haven't got any balls of the right size in the storeroom," the drill press man added.

"Couldn't you drill that bushing on the old big drill press?"

"It's all set up to true the holes in the back end of a main rod," the drill press operator said. "It won't take long to get this one going again if I can find them balls. It takes about thirty minutes to change that other drill press and get it set up with the boring bar again."

Evans dropped down on one knee. "Ouch!" he exclaimed. "Here's one of your balls if I can dig it out of my knee cap."

It took about ten minutes to find the other two and approximately the same amount of time to get the drill press going again. The foreman went to the storeroom to order a new ball bearing for the drill press.

"Have you got a parts catalog for the Willer drill press?" he asked the storekeeper.

"No, that company has been out of business more than ten years," the storekeeper replied. "Don't you remember we tried some time ago to order gears and bearings for it and finally had to have them made special?"

"Yes," Evans replied. "I remember, and I also remember the repair parts cost nearly as much as a new machine on account of having to be made special. The master mechanic sure did holler about it."

"Anything else you need?" the storekeeper asked.

"Yes, some balls for the spindle thrust bearing on the drill press, but I'm not sure of the size. I'll find out and let you know."

A FEW days later there was a memorandum from the master mechanic saying that a slotter and an 18-inch lathe from the dismantled shop should reach Plainville in a few days. A motor and starter for the slotter was also being shipped.

"That'll make it just right," Evans commented. "We'll hold up the 5090 and true up the driving boxes."

Next day a flat car containing the machines was set in at the machine shop. Evans, anxious to get them in service, got a gang of men and shoved the car into the machine shop so that the overhead crane could be used to handle the machines.

"Looks pretty tall," one of the men commented and pointed at the slotter.

It was pretty tall, in fact, the top of the slotter was nearly a foot too high for the machine shop crane to pass over it. Evans walked around the car and sized the slotter up from every angle, but it was no go. The machine was too top-heavy to take a chance on hooking down low and much too heavy for the portable crane to handle.

"Guess we'll have to call the bridge gang and have them unload it," Evans finally admitted after dismissing every idea he could think of for using available means he had.

The bridge gang was busy and couldn't get at the job until next day, Evans was told when he called the master carpenter. Next morning the bridge gang foreman came and looked the machine over. About two hours later a motor car came chugging up the track pulling two push cars loaded with enough heavy timbers to bridge a fair sized creek. The balance of the day was spent by the bridge gang as follows: One hour unloading timbers and stacking them; two hours jacking up the slotter and building a crib under it; one hour letting the slotter down and removing crib; thirty minutes loading timbers used on the job; one hour loading timbers not used on the job. By that time it was 4:30 and too late to think of trying to haul the timbers back to the lumber yard and unload it, so the gang left the loaded cars set on the spur by the side of the machine shop and put in the other thirty minutes calling it a day.

After the slotter was unloaded from the flat car it could be handled with the machine shop crane. Evans had a machinist and helper set the machine in place, then he looked it over. The machinist was examining it also.

"It's not fair," the machinist observed to no one in particular.'

"What's not fair?" a helper asked.

"Cheating the Japs out of scrap iron," the nutsplitter replied.

"Maybe it's better than it looks," Evans said. "Guess we'll have to make a gear for the table feed. That one looks like it's seen its best days. Where is the motor?"

"That must be it over there," the machinist pointed at a large crate. "It looks big enough to run the whole machine shop."

The motor was 15-horsepower slow speed and of a type that was built when manufacturers considered size an asset.

"Good gosh!" Evans exclaimed, "we can't hang that thing on the slotter; it would turn it over. Besides, there wouldn't be room to walk around it."

"Where are you going to put the countershaft?" The machinist indicated a cumbersome countershaft and four-

step cone pulley that brought back memories of whirling wheels, a criss-crossed maze of belts with jingling rings polishing miles of shafting that went out of style with peg top pants for men and hobble skirts for women.

"We'll not use them," Evans said. "And we'll have to get a smaller motor. Find the electrician and see if he can't locate a motor we can use."

"There is a spare 5-horse motor in the electric shop," the electrician said. "I believe it will be large enough."

"O. K., we can try it," Evans agreed. "What size pulley will we need?"

"How fast do you want the slotter to run?" the electrician asked. "The motor runs 1760 revolutions a minute."

The foreman measured the large pulley on the slotter and did a little figuring. When he had finished he shook his head. "Can't use a flat belt. The motor pulley will have to be only about four inches in diameter. Have you got some V belts in the electric shop?"

"How are we going to change the speed?" the machinist inquired.

"Have to just run it at one speed at least for the present," Evans said. "Soon as the electrician gets the motor up here, make a V belt pulley for it and have the blacksmith make some brackets to mount the motor on the side of the slotter. I guess a piece of ⅝-inch boiler plate with some slots for the motor base bolts will do to fasten the motor on."

The machinist did a neat job of mounting the motor as outlined by Evans and in reasonably short time. At the same time the electrician was running a line of conduit and wiring for the motor and starter. The job was finished, at least they thought, next day after the slotter was unloaded.

"Ready to run?" the electrician asked.

"Let her go!" the machinist said.

The electrician pressed the starter button and the machine started.

"Stop it!" the machinist said.

"What's the matter? Ain't it running in the right direction?"

"Yes, but the pulley on the slotter will have to have the crown faced off. All of the belts are trying to climb to the center."

Facing the pulley was a fairly simple job, but getting it off was something else. At some time the pulley had evidently worked loose and some one had made certain it wouldn't happen again by welding the nut shaft and pulley hub into one solid mass. To make matters worse, the nut was back in a recess where it couldn't be readily reached with a chisel to chip off the weld. A cutting torch did the job in a very unworkmanlike manner.

Two days were spent making a gear for the table feed, building up and grinding a ratchet pawl, tightening loose bolts, and otherwise going over the slotter.

When it was finished, Evans told the machinist to look over the 18-inch lathe and see what parts were needed to put it in running shape. He also asked the storekeeper to see if there was a suitable motor available anywhere on the system.

The lathe, like the slotter, had been a good one in its day and both may have served in the preparation for the first world war.

"What do you think about it?" Evans nodded in the direction of the antiquated lathe.

"The bearings are worn, there's about half an inch play in the feed screw, it needs a new tool post and cross feed, the tailstock is off centre, the taper in the head flares so it won't fit a straight taper, and I found one gear that doesn't have any teeth broken," the machinist said.

Evans groaned. "You forgot to mention that the ways that the tailstock rides is battered."

"Yes, and one leg is cracked almost through," the nut-splitter said cheerfully.

"Well," Evans sighed deeply, "guess we will just have to order a bunch of new parts. Check the gears needed and get dimensions and pitch. I'm sure they'll have to be made special. Might as well tear the lathe down completely, and we'll do the best we can to put it in shape to run. Give me a list of parts and I'll see what can be ordered and we'll make the rest. Being away out on the tail-end of the railroad has some advantages, but there are drawbacks, too. Most of the equipment we get comes out here to dodge the scrap heap." Evans turned and went back to the roundhouse office hoping for a few minutes rest, but he didn't find it.

"The dispatcher wants two 2700's or one 5000 quick as possible. A bridge burned out on the C. T. & W. and they are detouring a hot shot train over our road," John Harris, the roundhouse clerk, said.

"What's the matter with their engine?"

"It's a coal burner." Harris didn't need to add that the S. P. & W. no longer has coaling facilities on the west end.

"Tell the dispatcher to take his choice, two 2700's or one 5000—we haven't got either!" Evans started for the door. "I'll let you know in a few minutes, but it'll be a 5000, if any."

Evans went to the roundhouse, did a little figuring, OK'd several jobs on the 5091 that should have been done, came back to the office and chanced another Form 5 by running the engine. He then sat down to worry about what engine to use in the place of the 5091 that had been marked up to run that night. The foreman had little time to sit and accumulate wrinkles; the chair seat was barely warm when machinist Cox came in.

"Did you figure on trueing up the driving boxes off the 5090?" Cox asked.

"If the slotter is ready to run," the foreman said. "I held the engine up waiting to get the slotter in condition so I could true up the driving boxes. Did you caliper the boxes to see how badly out they are?"

"Yes," Cox replied, "and they sure do need it. The brasses I pressed out of the boxes were shimmed with everything from tobacco cans to Murphy roofing and then didn't fit."

"I'll go with you," Evans said.

The old slotter had been scraped and painted. It looked nice at a little distance and not so bad close up if a person didn't look too close and see that all of the nickel plating had worn off the control wheels and lever handles leaving them dull and ugly.

"Well, if it does as well as it looks, it will be good enough," Evans commented. "Have you tried it out yet?"

"Just a little to see how it works. I cut the teeth on the feed gear with it," the machinist said.

"Pretty fair job." The foreman stooped and looked at the gear. "How did you lay it out?"

"Just clamped the old gear to the blank and turned the table feed by hand," Cox said. "It took quite a little time."

"Yes, I can imagine it did. If our defense material had to be turned out on machines like this, the war would be over before we could build anything to fight with. Guess you might as well start on those driving boxes and see what it will do. I'll be back after awhile and see how you are getting along."

The machinist had not operated a slotter for some

time and he was a little slow getting the driving box set up and the tool set, but he made it. The first cut he started was too heavy for the aged machine. The tool chattered like it had a chill when it bit into the metal. Cox eased up on the cut and it did somewhat better. He first thought that one cut would be enough but soon found that two or maybe three would be required to true up the driving box.

Just as the final cut was being made, the master mechanic came in. The official walked slowly through the machine shop looking around as he went. Then he spied the slotter and walked over to the machine.

"Pretty good-looking machine," the master mechanic said. "How does it work?"

"Just fair," the machinist told him. "It works pretty good on a short cut, but the tool post won't stand very much cut on a long stroke."

The master mechanic stood and watched until the driving box was finished, then stooped to examine the bright surface of the newly machined metal.

While he was examining the driving box, Evans came into the machine shop. The foreman came over to look at the driving box. "Is this the first one you've finished?" Evans asked the machinist.

"Yes," Cox replied. "It's pretty slow."

"Well, anyway, you won't have any more excuses that crown brasses pound out because you haven't got a machine to true up the driving boxes," the master mechanic remarked.

"Let's see your calipers," Evans said to the machinist.

The machinist handed Evans a pair of inside calipers. The foreman adjusted the calipers and measured the opening in the box at each end. He frowned and looked at the calipers, then measured again.

"It would be all right if the brasses were made tapering to fit," Evans commented as he handed the calipers to the master mechanic.

"What's the matter?" the master mechanic asked.

"Tool post guides must be worn," Evans replied. "There's nearly three sixteenths of an inch difference in diameter between the two ends of that box. That's just about as bad as being out of round. Better see if you can't take some of the play out before you do the next one," he added to the machinist.

"Maybe you can get it fixed up in fair shape," the master mechanic said. "How is the lathe? When will you get it going?"

"Can't say," Evans shrugged his shoulders. "We've ordered a lot of gears and other parts that are needed to put it in shape to run. If we don't count the time put in on it, the lathe won't cost much more to repair than it would to buy a new one and chances are we wouldn't have got a new one anyway."

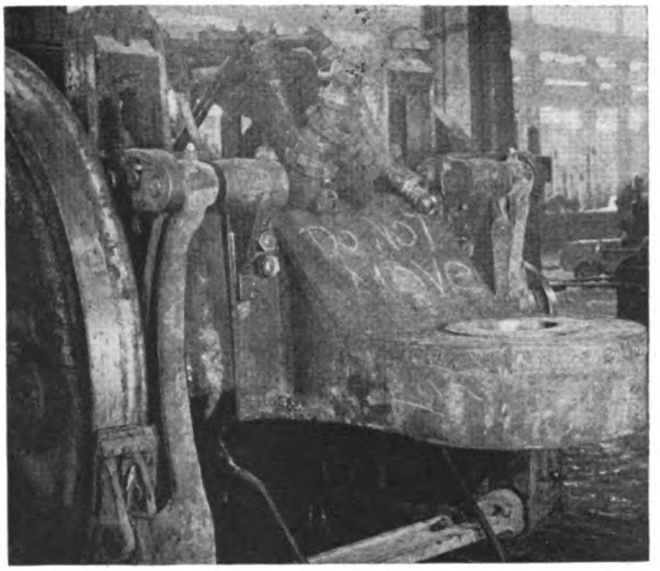
Fabricated Hinge Crossties

The group of four hinge crossties, illustrated, are designed for use in the front engine frames of articulated locomotives. They were fabricated completely by the welding together of steel plates at the Union Pacific locomotive shops, Omaha, Neb., and have the advantage of great strength combined with relatively light weight. They are made for the most part of 1-in. boiler plate cut and bent to the shapes indicated and welded together with suitable reinforcing inside ribs welded in place wherever necessary to give the required additional strength and stiffness.

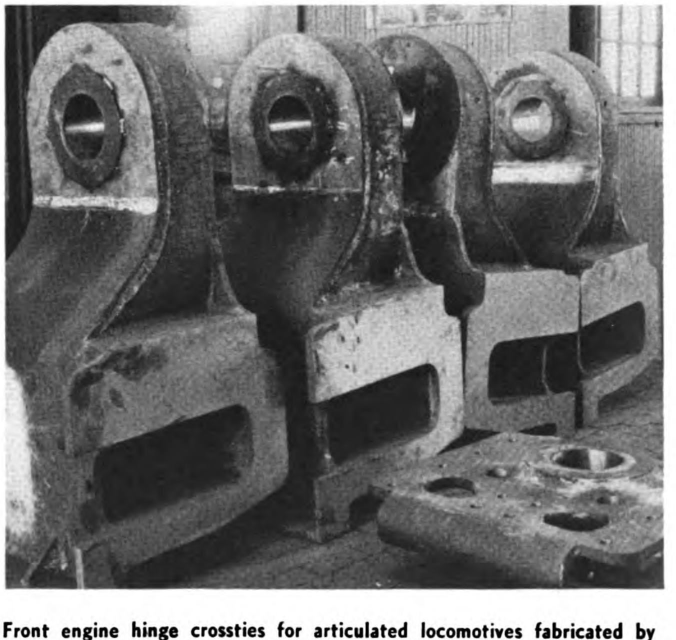
Considerable ingenuity was exercised in designing this hinge crosstie so as to minimize the number of individual plates required and hence reduce the welded joints to a minimum. For instance, the top is blocked out and offset, by far the greater part of it being in one piece. The base is made in one piece, cut to the required shape by means of the oxy-acetylene pantograph machine. The rounded part of the side is made in one piece and formed in a bulldozer. Flat parts of the sides are, of course, separate pieces and smaller rib reinforcing plates are cut separately on the pantograph machine, being scarfed so as to leave the edges at the correct angle for welding.

After all parts are suitably formed they are set in an assembly jig and all inside welds made. The bottom cover plate is then applied and the outside rims welded. A 14-in. by 9½-in. steel bushing is then pressed in, as illustrated. After completion of the welding, the crosstie is normalized at 1,550 deg., and drawn at 1,000 deg. F.

For a hinge crosstie of the size illustrated, it takes two men about 32 hr. to complete the welding operations,



Welded hinge crosstie for articulated locomotive fabricated from shapes and plate



Front engine hinge crossties for articulated locomotives fabricated by welding at the Omaha shops of the Union Pacific

$\frac{3}{16}$-in. shielded arc wire being used and deposited at the rate of approximately 3 lb. per hr. The finished crosstie weighs about 1,500 lb.

The bottom pin hub and spring housing, shown in the right foreground of the illustration is made of one piece of 1-in. boiler steel, 36 in. by 84 in., cut on a pantograph and bent in a bulldozer to the shape shown. Only one weld is required on this job to apply the front plate (not shown in the illustration), also one rib and one bushing. This type of construction assures an unusually strong and rigid assembly and one which has high strength per unit of weight.

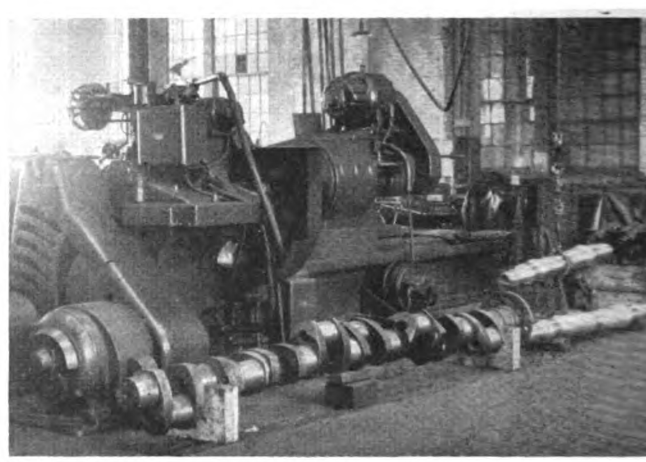
Grinding Diesel-Engine Crank Shafts

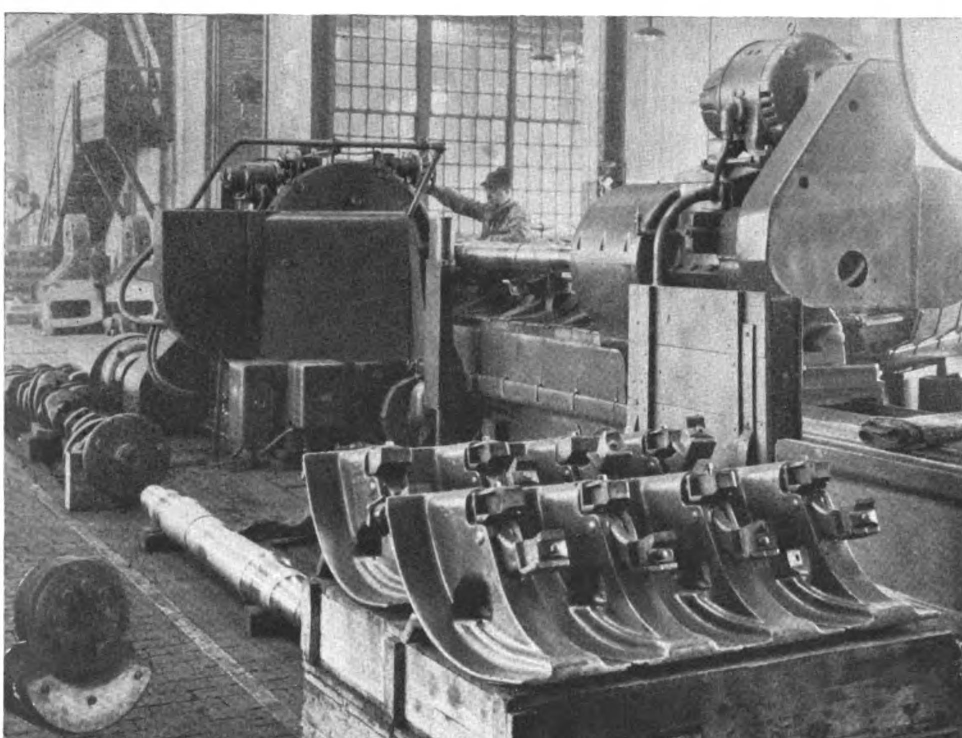
The job of grinding Diesel-engine crank shafts is more or less of a specialist's work and requires considerable experience before entirely satisfactory results can be secured. Worn bearings are checked for quarter and stroke and an attempt made to hold all bearings to the same size and accurate within 0.001 in. Crank shafts which have seen considerable service and wear are ground in step sizes of $\frac{1}{32}$ in., so that both main and crank-pin bearings, supplied in these standard sizes, may be readily installed both when the reconditioned crank shaft and Diesel engine are placed in service and also subsequently when, for any reason, a bearing may give trouble and have to be replaced by a new one from stock.

These operations are performed on a large cylindrical grinding machine built by the Landis Machine Company, Waynesboro, Pa. This machine has a capacity to swing work 29 in. in diameter by 169 in. long between centers. The first operation is to make a plunge cut with a 4-in. wide grinding wheel and then traverse the wheel for the width of the bearing. Scored bearings are cleaned up and all roughness removed, the bearings being reduced to the next $\frac{1}{32}$-in. step size in diameter.

Before the actual grinding operation, however, one of the most important jobs is to counterbalance the crank shaft so that it will revolve smoothly and apply steady rests to eliminate all possible flexing and chatter of the crank shaft. This is necessary whether main or crank pin bearings are being ground. The Diesel-engine crank shaft, as received dismounted from the engine, is shown in the foreground of one of the views resting on three blocks on the shop floor. As a matter of fact, the weight of this crank shaft itself in connection with its length is sufficient to cause some slight flexing and, when supported between centers in the grinding machine, it is said that the operator can move one of the center bearings out of line as much as .02 in., by a strong hand pull. In attempting to grind these bearings throughout the length of the crank shafts to an accuracy of .001 in., therefore, the importance of the greatest care in counterbalancing the shaft and eliminating all possible flexure and vibration is at once apparent.

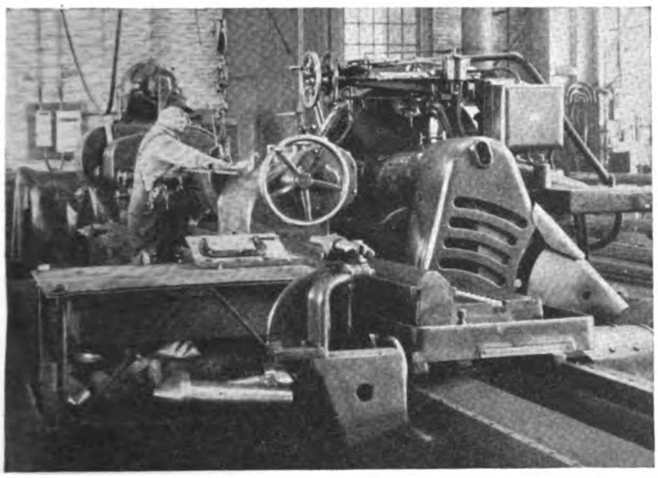
In one of the views, taken from the back of the grinder, a group of eight steady rests used in grinding Diesel-engine crank shafts is shown in the right foreground, and one of the two combination centering and counterbalancing fixtures used in supporting the crank shaft between





Above:—Rear view of Landis grinder with a Diesel engine crank shaft shown in the foreground ready to have the bearings ground. Left:—The grinder is used at the U. P. Omaha shops for refinishing Diesel engine crank shaft bearings, also locomotive and car axles, etc.—Counterbalanced centering fixtures and steady rests in the foreground

grinder centers is shown in the left foreground. This combination fixture is particularly ingenious in that it is designed to be clamped on the end of the crank shaft, carry adjustable counter plates which may be varied, dependent upon the type of crank shaft being ground and be designed to support the crank shaft between grinder centers in any one of eight balance angular positions, dependent upon which crank pin or bearing is being ground. The change in angular position of the



View of the Landis grinder from the operator's side of the machine, showing conveniently located grinder controls

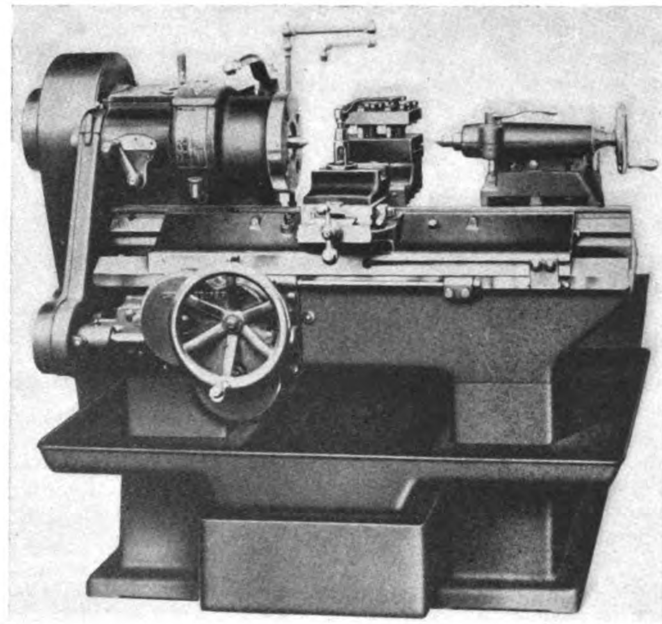
counterbalance plates permits this one fixture to be used for grinding all of the bearings on a single Diesel-engine crank shaft without adjusting the counterbalance plates for each new bearing to be ground, as would otherwise be necessary.

While the Landis cylindrical grinding machine was installed primarily for grinding Diesel-engine crank shafts, it is also used for grinding locomotive axles used with roller bearings and also grinding all over the car axles used in streamline trains to remove all tool marks and stresses from turning operations which might cause progressive fractures. The Norton grinding wheel is 38 in. in diameter by 4 in. wide and revolves, for most work, with a surface speed of 5,000 to 6,000 ft. per min.

Multi-Cut Lathes for Turning and Facing

The R. K. LeBlond Machine Tool Co., Cincinnati, Ohio, has developed 6-in. and 9-in. multi-cut lathes designed for the easy set-up of separate tools for turning, facing, necking and grooving cuts. All of these cuts go through their cycles and finish at the same time. The operation is automatic from the time the work is put into the lathe, the lead tool brought up to the work and the power and feed lever thrown into action. At the end of the cycle of cuts, the hand wheel is used to return the tools ready for the next part to be machined.

The variation in feed for the turning and facing size is obtained by the application of change gears to the feed bracket and worm box. The feeds read in thousandths per revolution of spindle. A simple, direct-reading, work diagram shows the change-gear combination and the resulting feeds. The relationship between the slides is quickly adjusted by the setting of the movable profile swivel plate. As the facing or forming tools approach



LeBlond multi-cut lathes are designed for the easy set-up of separate tools for turning, facing, necking and grooving cuts

the end of the cut, the feed is retarded as the roller slides on the land of the profile guide plate.

With these machines the set-up is simple and the machining cycle is accomplished by many tools cutting simultaneously. By this method, on the time required for the longest individual turning or facing cut depends the machine time for the piece.

Locomotive Boiler Questions and Answers

By George M. Davies

(This department is for the help of those who desire assistance on locomotive boiler problems. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless special permission is given to do so. Our readers in the boiler shop are invited to submit their problems for solution.)

Punching Holes in Firebox Sheets

Q.—Is it considered good practice to punch staybolt holes in new firebox side sheets? What size should the holes be punched in the sheets for 1-in. staybolts, and for ⅞-in. rivets?—A. L.

A.—It is the accepted practice with many railroads and with the locomotive builders to punch the holes in the firebox side sheets for both rivets and staybolts. When punching staybolt or rivet holes, the metal around the punched hole becomes strained and distorted. It is important that the punched hole be made of such diameter that the strained and distorted metal around the punched hole is completely removed when the hole is reamed out. The failure to remove all of the stressed metal is often the cause of cracks starting around the staybolts.

The practice of punching holes for staybolts in firebox side sheets varies. The general consensus is that the punched holes should be from ¼ to $\frac{5}{16}$ in. less in

diameter than the nominal diameter of the staybolt tap. The punching should be done from the water side of the sheet. For rivet holes in firebox sheets under $\frac{9}{16}$ in. in thickness, the holes are punched $\frac{1}{8}$ to $\frac{3}{16}$ in. smaller than the required diameter and reamed to the required diameter after the sheets are assembled.

Chemicals Used in Feedwater Treatment

Q.—What chemicals are generally used in the treatment of boiler feedwater to prevent foaming and scale?—W. I. D.

A.—The most common chemicals used in the treatment of boiler feedwater for the prevention of foaming and scale are soda ash, caustic soda, sodium phosphate and sodium silicate.

Soda ash is what is known as a softening chemical. It reacts with the calcium or lime hardness in water. Soda ash, under the temperature encountered in boiler water, is broken down to caustic soda which reacts with magnesium. It is probably the most universally used chemical for internal treatment of boiler feedwater and most boiler compounds contain soda ash in some quantity.

Caustic soda combines with magnesium hardness and is of especial advantage in waters that contain magnesium in high percentages. Caustic soda is also used where the water is particularly corrosive due to carbon dioxide gas in the feedwater. Sodium phosphate comes in several different forms; namely, tridi-, mono- and meta-sodium phosphate. The phosphate reacts with calcium to form a sludge which is non-scale forming. The phosphates are exceedingly stable and for this reason are used extensively in high-pressure boilers.

Sodium silicate, another material used extensively in boiler compounds, is used chiefly because of the soda value in the sodium silicate. Some claims have been made that the silicate part of the sodium silicate forms a coating on the boiler metal to prevent the adherence of scale. This has not been proved conclusively and many cases are known where a silicate scale has been formed due to the use of sodium silicate compounds. Good results are sometimes obtained with this material in low-pressure or heating boilers.

Purpose of Steam Dryers

Q.—What is the purpose of steam dryers used in locomotive boilers? How do they operate?—F. A. R.

A.—The purpose of the steam dryer is to remove the water from the steam flowing into the superheater. The carrying over of the water reduces the efficiency of the boiler because the degree of superheat is lowered by the water carried through the dry pipe into the superheater. The carry-over of water into the superheater tends to cause internal encrustation of the superheater units. Steam dryers also tend to eliminate water caused by surging and foaming from entering the superheater.

There are several designs of steam dryers involving different principles. The dryers are fitted on the top of the dry pipe bootleg in the dome. One design consists of fixed turbine-shaped vanes arranged within the body of the dryer, causing the entering steam to be whirled around at high velocity. As a result the water is centrifugally separated and ejected through the tangential outlets. The fixed vanes are designed to impart a whirling motion to the steam producing sufficient kinetic energy in the separated water to return it to the boiler against the boiler pressure.

Another design consists essentially of two concentric hollow cylinders. The inner cylinder is perforated with diverging velocity nozzles and the outer cylinder wall contains a series of fixed turbine blades. The steam from the boiler flows through the fixed turbine blades of the outer cylinder and is deflected downward in the space between the two cylinders, the steam being forced to change its direction in order to pass through the nozzles of the inner cylinder. The inertia effect of the steam entering the projecting velocity nozzles of the inner cylinder and the reversal in the direction of the steam flow separates the entrained water which drains down the outside walls of the inner cylinder back into the boiler. The steam passes through the nozzles of the inner cylinder into the dry pipe.

Seal Welding on Boiler Shell Patches

Q.—In the September, 1940, issue, page 370, of the *Railway Mechanical Engineer* you have an article headed "Improved Method of Applying Boiler Patches." In Fig. 4 of this article you show a method of patching the second course of a boiler shell which calls for seal welding the filler wedge to the shell. It has always been my understanding that this welding constitutes a Federal defect. Please explain how this is got around as in some cases this would be most advantageous, if allowed. —V. L. L.

A.—The patch referred to in the question was one of the entries in the prize competition on boiler patches, announced in the March, 1939, issue. These patches are being published to give you a cross-section of boiler patches as they are being applied by the various railroads.

The patch in question illustrates a method of patching a circumferential seam without planing or scarfing the end of the patch, heating and opening up the circumferential seam and inserting the patch and then heating and laying up the circumferential seam. This was done by applying a wedge-shaped filler piece to raise the outside plate of the patch by the thickness of the shell course. This feature of the patch was considered worthy of publication. The Bureau of Locomotive Inspection proposed rules for welding provides that welding shall not be applied to any part of the barrel, dome, drum or hip sheets of any boiler unless the stresses to which the part is subjected are carried by other constructions that will maintain the required factor of safety. This will not prohibit welding of joints of shell sheets at the ends of the butt straps to seal leakage, or prohibit the welding of staybolt sleeves or caps in that portion of the barrel into which the combustion chamber extends. In all cases the railroad company is held responsible for the design, material, application, inspection and safety of fusion welding, applied to any locomotive.

The contributor of this patch states: "Our interpretation of the rule of authority for welding the wedge one inch on each side where it butts against the outside throat sheet in this particular sketch is the same as on the construction of a course, which formerly was sealed with a plug between the edge of the outside welt strip and the circumferential seam of the next course, but as you know in recent years welding takes its place. (This is permissible under the I. C. C. ruling.)

"To further explain this, would say that this weld is covered by the outside plate as well as the inside with the exception of the $\frac{1}{4}$ in. allowed in width to make a caulking edge for the outside plate. We have made several applications of this type patch and find them very satisfactory as to cost of application and the results obtained, and cannot see any reasonable cause to question it as this weld is on the wedge only, acting as a seal as its name implies and has nothing whatever to do with the efficiency of the patch.

Questions and Answers On Welding Practices

(The material in this department is for the assistance of those who are interested in, or wish help on problems relating to welding practices as applied to locomotive and car maintenance. The department is open to any person who cares to submit problems for solution. All communications should bear the name and address of the writer, whose identity, however, will not be disclosed when request is made to that effect.)

Creeping Gages And Regulators

Q.—We are troubled with creeping oxygen gages or regulators on portable outfits. Is it safe to use these regulators?

A.—Creeping or leaky oxygen regulators should never be used and when one is found, it should be turned in to the storehouse for a new one. Not only is it impossible to maintain a suitable working pressure, but at any moment the pressure may build up in the hose and blow a hole in it causing an accident.

Removing Loose Driving Wheel Keys

Q.—Could you suggest a method for removing loose driving wheel keys?

A.—Cut off the head of a bolt with a good thread and a body size near the size of the key to be removed. Clean the end of the key and scarf the bolt for welding, either single or double V. Weld the bolt securely to the end of the key. Slip a bushing and washer over the end of the bolt until just enough bolt remains to take a full nut. As the nut is tightened, the key will come with the bolt, more washers are added, as needed, until the key is removed.

Cleaning the Orifice In A Torch Tip

Q.—Please recommend an instrument for cleaning out welding and cutting tips.

A.—The holes in cutting and welding tips are designed and drilled to very close tolerances, therefore, any instrument used to ream these holes, other than a drill of the exact size, tends to enlarge the orifice and ruin its efficient operation. The manufacturer of the equipment will gladly furnish a chart giving the correct number drill size for each tip. The drills can be used in a pin vise or soldered into the end of a 2-in. or 1/4-in. bronze welding rod knurled for a firm grip.

Reclaiming Worn Valve Stems

Q.—We have a number of valve stems with the threads and tapered fits worn too badly for continued use. Can these be reclaimed by welding and if so by what process?

A.—These valve stems with worn or pulled out threads and worn out tapered fits, caused generally by loose crossheads or loose valve spools, are usually otherwise in good condition. The threads should be turned off the stem before attempting to rebuild this end. When rebuilding, use a medium size welding head, a neutral flame and a soft, low-carbon-steel welding rod: Care should be exercised in depositing the new metal to keep it free from laps, slag pockets and oxide inclusions.

Building Up Guides By Arc Welding

Q.—We weld the worn sides of guides by the electric arc process using bare electrodes. While the resulting surface is satisfactory, the operation takes so long that it is almost prohibitive. Could you suggest some method of speeding up the welding of these guides?

A.—Arc welding locomotive guides with bare rods has been a noted time killer, sometimes taking as long as 10 hours on one guide. Try substituting heavy coated electrodes for bare rods and increase the size of the electrode from the usual 5/32 in. or 3/16 in. to 5/16 in. or 3/8 in. sizes, depending on the wear of the particular guide. This method will cause little or no warping and the only precaution necessary is in depositing the initial bead along the edge of the guide. This bead must be laid about 3/8 in. in from the edge of the guide and worked out toward the edge with a semi-circular motion so as not to burn away the edge of the guide.

Cutting Cast Iron With Acetylene Torch

Q.—Can cast iron be cut with the acetylene torch?

A.—Cutting cast iron with the torch is not as simple nor as rapid as the cutting of steel. It can be done, however, with little extra effort. Use a larger tip size than for the same thickness of steel. Adjust the preheating flame so that it shows an extensive amount of acetylene. The tip must be held farther from the material to be cut, and the material will have to be preheated longer. In fact, the edges should be molten before the high pressure is used. When the cutting is started, the tip is moved from side to side very slowly. It will be found advantageous on light castings to preheat and blow away molten metal alternately.

Removing Smoke-Arch Cylinder-Saddle Bolts

Q.—Could you recommend an economical way of removing smoke-arch cylinder-saddle bolts?

A.—These bolts can best be removed with two cutting torches. One operator cuts the head from the bolt and starts piercing the body of the bolt; simultaneously, the other operator cuts the nut from the same bolt and also burns into the bolt. When the operator on the outside notices the slag from the torch inside blowing through, he removes his torch while the other operator finishes splitting the shell so that it can be driven out with a hand hammer and punch. Two minutes to each bolt is an average time.

Repairing Rusted Car Side Sheets

Q.—We have developed an unsightly condition on steel passenger coaches wherein the rust has forced the bottom of the outside sheets out below the rivets so they look very bad. Can you suggest a method of repair?

A.—This is a common occurrence and can be repaired easily. Holding a cutting torch parallel with the bottom edge of the sheet, the rusted section is burned off about 1/2 in. below the rivets. Care should be taken to keep the cut as straight as possible. The rust is removed and the slag cleaned from the cut and a piece of 1/8-in. band iron of the proper width is welded back in place, either with the torch or the electric arc process. The weld is ground flush and the new metal primed and painted.

Electroplating Work at Omaha

ELECTROPLATING work of all kinds for the Union Pacific System is done in a modern electroplating department. All dining car silverware is plated in this department and all hardware is nickel-plated with a satin finish and lacquered to preserve the lustre. Screws intended for use in exposed trim of passenger cars are cadmium plated to prevent rust. Arrangements are also now being made for a small amount of chromium plating on parts where a hard, durable finish with excellent wearing properties is required. In addition to electroplating, all lock and key work for the system is done in this department.

The electroplating department at the Omaha car shops occupies a space 90 ft. long by 84 ft. wide along the shop wall where excellent light during the day is supplemented by overhead electric lighting fixtures for use when needed on dark days or for double-shift operation. The equipment includes 10 plating tanks with different types of solutions. These tanks are arranged in five rows, and only part of them are included in one of the illustrations. This shows the silver plating tanks in the foreground and the two long nickel- and copper-plating tanks in the background. The latter tanks are 16 ft. long by 3 ft. wide by 4 ft. deep and have a capacity of approximately 1,500 gal. each.

Machine equipment in the electroplating department includes four buffing and polishing machines which operate at a speed of 3,600 r.p.m., two metal lathes and two sensitive drill presses. One interesting piece of new equipment recently installed is a small tumbler barrel, shown separately in one of the illustrations, which is power driven and used for nickel and cadmium plating parts such as small screws with a notable saving in time and labor as compared with previous methods.

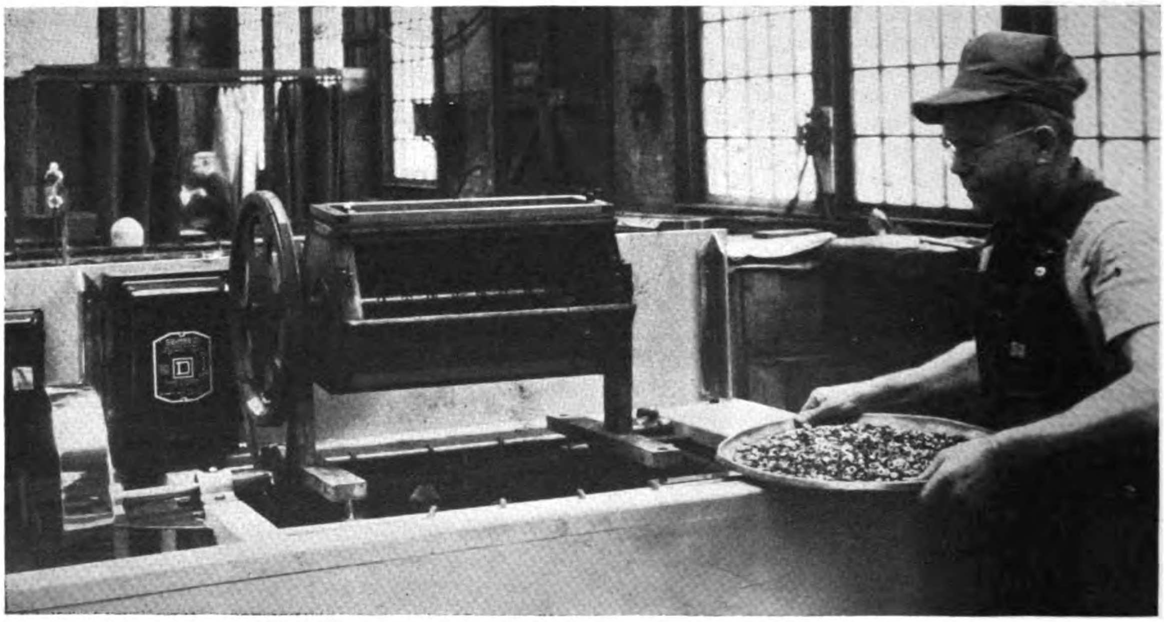
With the considerable increase in electroplating requirements at the Omaha car shops, it became necessary about a year ago to furnish additional electric power and a new 2,000-amp. d. c. motor-generator set, furnished by the Hanson-Van Winkle-Munning Company, Chicago, as shown in one of the illustrations. This motor-generator set is designed especially to meet the requirements of satisfactory electroplating and includes all necessary rheostats, electric meters, switches and control equipment, combined on two switchboards as shown at the right in the illustration.

The satisfactory application of silver plating is a specialist's work, involving in Union Pacific practice 16 separate and distinct operations, which will not be considered in detail in the present article. As many as 6,000 pieces of silver a month have been replated and refinished in this particular department at the Omaha shops.

In nickel plating also particular care is necessary to get the desired results at minimum cost. The nickel is stripped off by the electric process, using a reverse current with the nickel-plated parts suspended in an acid bath. The parts are roughed off with No. 80 emery on a buffing wheel and polished with No. 120 emery. The parts are then cleaned in an Oakite solution and pumice stoned to remove impurities which would interfere with subsequent nickel plating. After being immersed in a nickel strike for 15 min., the parts are removed and placed in a copper-plating bath for 30 min. They are then transferred to the polishing machines and brought to a bright lustre. The parts then go back to the Oakite solution for cleaning off all grease from the polishing machine, then immersed in a cyanide dip, rinsed off with clean water, replaced in the nickel solution for 30 min., removed, polished and lacquered to retain the lustre.

Plating Small Parts in Tumbler

The tumbler shown separately in one of the illustrations, has proved to be a great time saver in the nickel-plating of such parts as signal contacts and all screws, which formerly had to be plated with the use of considerable more hand labor. As many as 3,000 screws

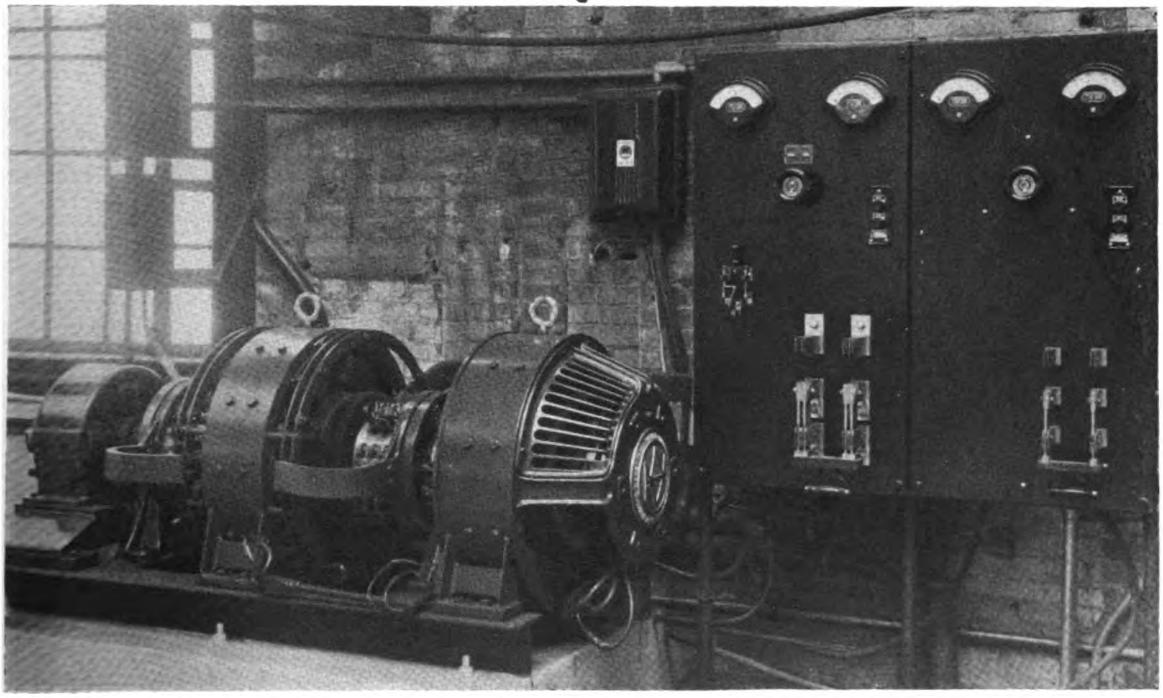


Power-driven tumbling device which saves time and labor in electroplating screws and other small parts

The electroplating tanks and one of the silverware buffing wheels at the Omaha car shops of the Union Pacific

can be plated with this device in a period of 20 min. The device consists of a hexagonal wooden tumbler 18 in. long by 10 in. across the sides, equipped with 10 wire feelers which revolve inside as the screws are tumbled, these feelers making electric contact with the screws as they are agitated and moved about when the tumbler revolves in the electroplating bath under the belt drive from a one-half horsepower electric motor (not shown in the illustration). This motor operates at 1,720 r.p.m., with worm and gear drive to a small pulley which drives the larger tumbler pulley by means of a V-belt. The small pulley is 3 in. in diameter and the large pulley 14 in. in diameter. The nickel-plated guard, shown at the left in the illustration is applied over the worm-gear drive, both as a safety measure and to prevent oil from being splashed.

The tumbler is shown in the loading position in the illustration with one side removed for the insertion of the screws to be plated. After these are placed in the tumbler, the side is applied and held securely in place by thumb screws, the tumbler then being inverted in position and lowered into the nickel-plating solution in the tank. Electric current enters the barrel by a bus-bar connection to the center shaft and thence to the 10 wire feelers, which make repeated contact with the individual screws or parts to be electroplated. An ordinary load for this tumbler consists of 50 lb., and the current ranges from 60 to 75 amp.



The Hanson-Van Winkle-Munning motor-generator set and control equipment especially designed for use in electroplating

Induction Heater Used To Remove Bearing Sleeves

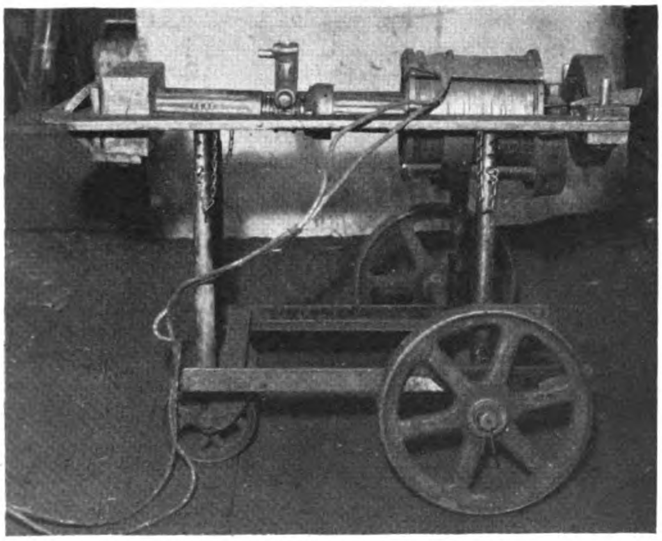
To remove the bearing sleeves (inner races) from axles equipped with roller bearings, the Erie car shops at Susquehanna, Pa., have developed an induction heater which permits this work to be completed quickly and safely. These sleeves have a shrink fit on the axle and, to be removed, must be expanded by heating. The only alternative is to loosen the sleeve by cutting which, of course, requires a new sleeve when reassembling the bearing on the axle.

The effectiveness of any method employed to expand the sleeves by heating depends upon its ability to raise the temperature of the sleeve while the axle journal remains relatively cool. Formerly, the Susquehanna shops used hot oil to heat the sleeves. The results by this method were not only unsatisfactory due to the slowness with which the heating was accomplished, the length of time required being sufficient to heat the axle as well, but the hot oil also made the operation hazardous for the workmen. The induction heater has eliminated these difficulties.

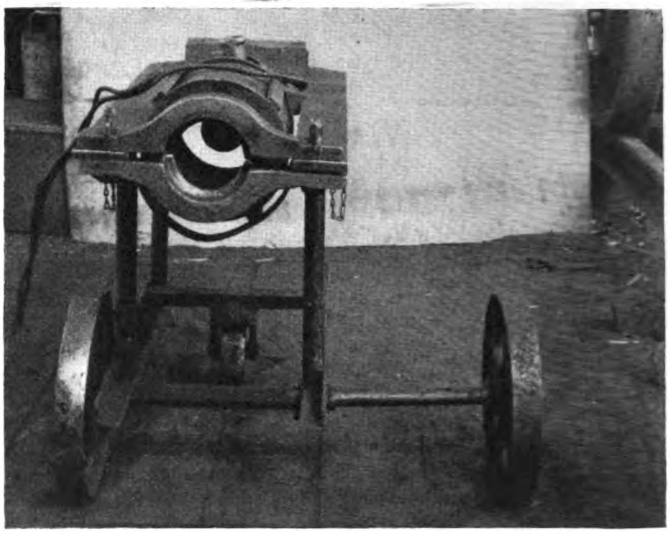
Essentially, the induction heater consists of an electric coil mounted on a carriage. In making the coil a Micarta spool, having an 8-in. inside diameter and an 8⅜-in. outside diameter, was used. This spool was wound with No. 8 Delta Beston wire, 190 turns for operation on a 220-volt line and 380 turns for 440 volts. The coil is supported by straps, as shown in the illustration, and is removable for convenience when employing the coil to heat the sleeves before applying them.

The carriage for the coil is of welded construction with four vertical supports of telescoping tubes. The inside tubes are adjustable for height, the tubes being held in position by pins inserted through holes drilled along the length of the tubes. A screw jack is mounted on a horizontal yoke, its axis being along the projection of the center line of the coil. At the front of the coil is a split collar that fits around the car journal in back of the sleeve. Collars of different diameters are available for the various sizes of journals.

When removing a bearing sleeve, the equipment is centered in line with the axle journal, the coil being placed around the sleeve with the collar fitted over the journal between the inside face of the sleeve and the wheel hub. The jack is run up against the end of the axle and tightened. This operation places the sleeve under an initial force tending to slide it off the journal. The coil is then energized by connecting it to the power source (440 volts at the Susquehanna shops). The sleeve, acting as a short-circuited secondary coil, is heated very rapidly, 25 to 35 seconds being the time usually required. As the sleeve expands on heating, it becomes loosened on the journal and is quickly removed by further jacking. Care must be used in heating because the sleeve temperature can be raised in a very short time to a point where the physical characteristics of the metal are affected. The time required for heating is so short that the journal temperature is not increased sufficiently to counteract the expansion of the sleeve.



The portable induction heater and jack



The split collar diameter can be changed to fit any journal size

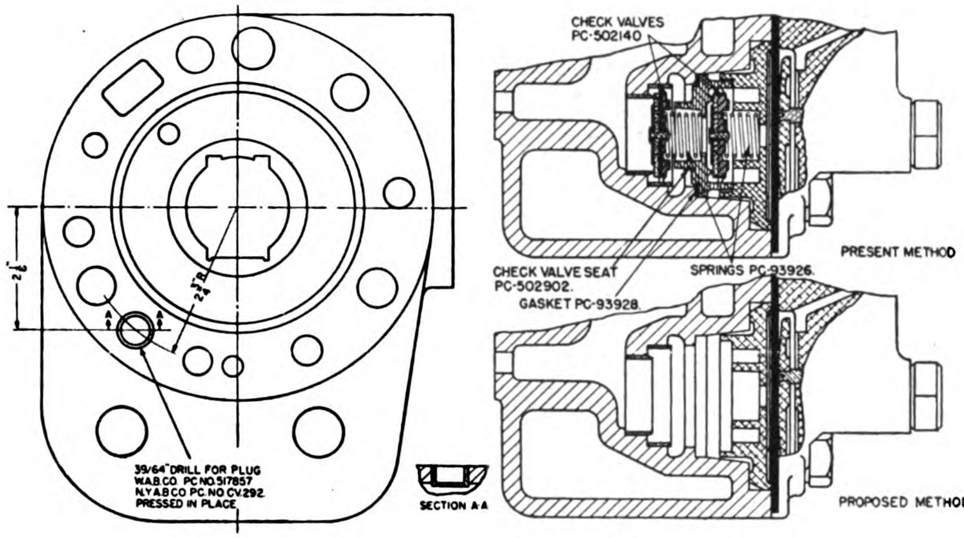
The coil is removed from the carriage and placed in a vertical position on a wood base when it is used to heat a sleeve before its application. The heating period is timed by a watch to prevent overheating. When hot, the sleeve is handled by special tongs and slid on to the journal by tapping with a wood block. A gage locates the sleeve in its proper position on the journal.

Elimination of AB-Brake Refinement Recommended

The elimination of two by-pass check valves from the service portion of the Type-AB air brake valve has been recommended in Circular No. C. V.-999, recently issued by the Association of American Railroads, Operations and Maintenance department, Mechanical division, by direction of the General committee and over the signature of Secretary A. C. Browning. This circular refers to the inclusion of the two by-pass check valves which are intended to operate so as to permit an application and release of the brakes with the strainer clogged. Since none of these by-pass check valves have been required to operate in over three years of service, their removal is recommended, including the following detail parts:

Reference number	Description	Piece number
48	By-pass check valves (2)	502140
49	By-pass check valve springs (2)	93926
50	By-pass check valve seat	502902
52	By-pass check valve seat gasket	93928

Sketch of Type-AB brake valve service-portion face, showing location of port to be plugged—Cross-sections show how by-pass check valves are discarded



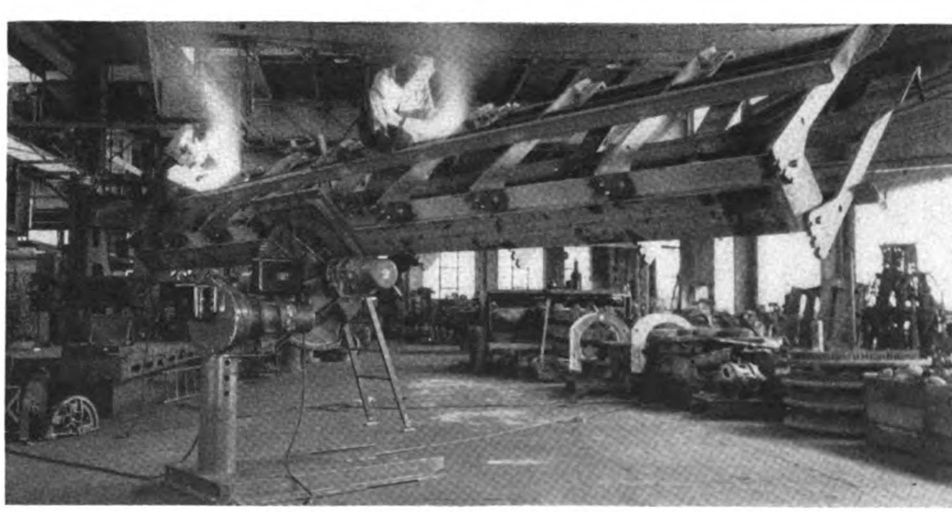
The circular included the following paragraph in explanation of the action recommended: "After careful consideration and following the full examination of cars equipped with experimental Type-AB brakes, the Committee on Brakes and Brake Equipment has recommended that the by-pass check valves may be omitted without affecting the integrity of the AB valve, as it is apparent that after three years or more of service none of these by-pass assemblies had been required to operate. This recommendation was referred to the Bureau of Safety, Interstate Commerce Commission, which Bureau, in view of the facts stated above, has no objection to the elimination of these parts. These parts should, therefore, be removed and, as shown on the attached sketch of the service portion face, the port should be drilled to 39/64 in. diameter and suitably plugged."

Welding Positioner

In the assembly of products by welding, units to be handled and fabricated are often of large size and shape, requiring crane service for lifting and moving. The C-F positioner is designed to simplify and eliminate many of the motions and save much of the time required to handle these heavy and unwieldy parts. Standard features common to all models of this machine are the table tilt from horizontal to 135 deg. from horizontal, complete table rotation, table height adjustment, and table removal for the installation of special fixtures or jigs.

The rotating and tilting movements in every machine are independent in action. Hand wheels with self-locking gears control these movements in manually operated machines. Machines operated by hand have a disengaging mechanism which permits free rotation so that a balanced or circular part may be turned without the use of the hand wheel. For power-operated rotation this same action is accomplished by use of a variable-speed drive. Power-operated rotating and tilting movements are controlled by independent motors with magnetic starters and push-button control. The table-tilt mechanism includes a limit switch which cuts off the power supply when the table reaches either extreme position. The table may be adjusted for height by sliding the unit up or down the base column and pinning in position.

The welding positioner is available in four models, Nos. 12, 25, 60 and 140, having capacities of 1,200, 2,500, 6,000 and 14,000 lb., respectively. The two smaller machines can be equipped for either manual or power operation while the larger machines are power operated only. Variable-speed table rotation ranges from 0 to .67 r. p. m. in all machines except the largest where the range is from .087 to .625 r. p. m. Constant-speed table rotation is 1.6 r. p. m. for No. 12, 1.0 for No. 25, .8 for No.



Large parts are maneuvered easily for down-hand welding when attached to the table of the C-F positioner

60 and .58 for No. 140. Table tilt speed is 135 deg. in 20 seconds for No. 12, 135 deg. in 30 seconds for Nos. 25 and 60 and 135 deg. in 34 seconds for No. 140. These machines are a product of the Cullen-Friestedt Co., Chicago.

Fork Truck Designed For Congested Areas

The Baker-Raulang JOM center-control fork truck is available in capacities of 2,000 and 3,000 lb.

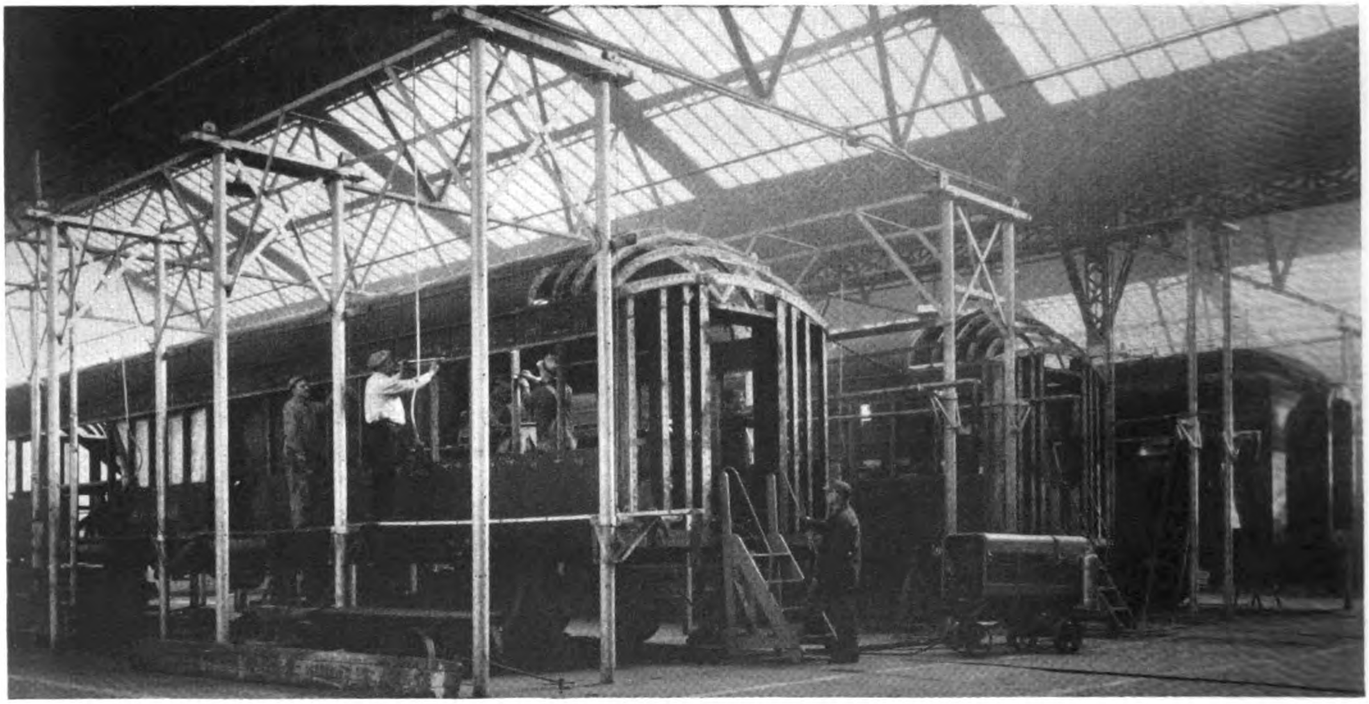
The latest addition to the line of industrial trucks manufactured by the Baker Industrial Truck Division of the Baker-Raulang Company, Cleveland, Ohio, is its new type JOM center-control fork truck which is available in 2,000- and 3,000-lb capacities. The compactness of this model, combined with the short turning axle, makes it particularly adapted for working in close quarters. The safe and speedy handling of material is assured since the operator rides in front where excellent vision is obtained. The operator's comfort, important to increased production, has been kept in mind by the installation of a seat and an automobile-type tilted steering wheel.

A high-capacity mill-type safety contactor is interlocked electrically with the controller and the operator's seat for greater safety. This contactor relieves the controller of arcing and automatically opens the circuit when the operator leaves his seat. The travel circuit closes only with the operator seated and the controller in the first speed position. All controls are conveniently grouped in a panel at the operator's left. The absolute control of hoisting and tilting operations is obtained in the hydraulic system. A motor-driven gear pump supplies oil under pressure to the hoisting and tilting cylinders through metering valves, the excess oil being bypassed to the reservoir through unloading valves. Lowering is by gravity. The hydraulic lines are copper tubing and high-pressure wire-inserted oil-proof hose.

The frame is fabricated of high-tensile steel by arc welding and hot riveting with main sills of deep-section flange plate members running from end to end. The upright guides are formed steel channel sections. The fork carriage travels on ball-bearing rollers. The power is supplied by a single hydraulic jack with the piston movement being compounded by a pair of chains and sprockets.

The 2,000-lb. capacity truck is designed to handle loads up to 60 in. in length and the 3,000-lb. model will handle loads up to 42 in. in length. The standard simple lift is 72 in., the standard telescoping lift is 119 in. The driving tires are 22 in. by 6 in., the trailing tires, 15 in. by 5 in.

* * *



Passenger car ends being rebuilt at the Southern Pacific shops, Sacramento, Cal.

(*Turn to next left-hand page*)

High Spots in

Railway Affairs . . .

Army Will Operate a Railroad

The War Department has secured the Red River & Gulf Railroad a 58.7 mile line in Louisiana, to be used as a sort of "military railway laboratory to test all sorts of war-time operations." The road will be extended to about 86 miles and will operate as does a commercial railway, but using military personnel. The 711th Engineer Battalion (Railway Operating) is being formed to take charge of it. The battalion will consist of about 20 officers and 750 enlisted men. The Army has specially designed, light-weight railway equipment, consisting of 20-ton cars and 30-ton locomotives for use in hastily prepared railways of forward areas; these will be tested as to design, uses and efficiencies. Volunteer requests of engineer reserve officers, with the concurrence of railway management, for extended active duty with the battalion are "being received in adequate numbers." After a brief course at the Engineer School at Fort Belvoir, Va., these officers will serve for one year with the battalion and will then be replaced by another group. A nucleus of enlisted men will be provided by the transfer of individuals who have had railroad experience and who are already in the military service. The remainder of the battalion will come from the Engineer Replacement Training Center at Fort Belvoir.

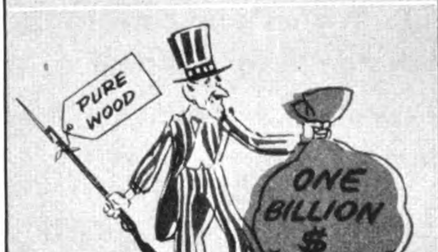
Statesmanship Required

There can be no question concerning the sincerity of that group of men in Congress who fought so hard to produce a Transportation Act in 1940 that would go a long way toward solving the transportation problem in this country. Despite their efforts, which extended over several years, the Act fell far short of what had been hoped for it. There was a frank admission of this in the provision in the Act for a Transportation Study Board, which is charged with the task of making studies to determine how the various types of carriers "can and should be developed so that there may be provided a national transportation system adequate to meet the needs of the commerce of the United States, of the postal service and of the national defense." It specifically requires, also, that the extent to which the different types of carriers are subsidized should be determined, and that complete facts should be assembled as to the taxes imposed upon them by all agencies of government. The President was slow in appointing the board and Congress none too prompt in approving of it and appropriating funds with which to carry on its activities. The personnel of the board has also been criticized —their comparative youth, the fact that the board is made up of two New Dealers and an "Independent" in politics, etc. Be that as it may, the board is faced with a stupendous assignment, the successful handling of which will mean much to the future prosperity of this country. Or it may be so handled as to pave the way for government ownership of the carriers and lead to the invasion and breaking down of that spirit which has developed the resources of this country and given our people the highest standard of living of any nation in the world—the spirit of private enterprise.

Why Defeat St. Lawrence Waterway

The cartoons shown below are part of a popular educational campaign that is being waged by the Railroad Co-operative League of Michigan. This association is composed of railroad employees and citizens.

It could not possibly be completed before 1945—when the war will probably be ended.



And the billion dollars it would cost Uncle Sam are now badly needed for defense.

It could operate only seven months of the year—it would create no new markets.

Taxpayers Pay For This

The Temporary National Economic Committee, familiarly known as the T. N. E. C. and more generally known as the Monopoly Committee, has been releasing a series of monographs prepared by individuals, and for which, apparently, the committee accepts no responsibility. In one of these monographs, No. 26, entitled, Economic Power and Political Pressure, prepared by two economic experts of the T. N. E. C., there is a chapter on utilities and railroads. In it the statement is made that "estimates of the amount of money spent by the A. A. R. and its numerous subsidiaries on propaganda and lobbying activities are so high as to be almost incredible, running to far over a hundred million dollars for the period since 1918." Donald C. Blaisdell, who wrote this part of the monograph, gave as his authority for this statement an article which appeared in Labor, the weekly newspaper published by the railroad labor organizations.

J. J. Pelley, president of the A. A. R., characterizes the statement in the monograph as "so outrageously unfair and so palpably false that I cannot refrain from calling it to your attention." In great detail Mr. Pelley then shows that expenditures to the extent of some $182,000,000 were made by the railroads from 1920 to 1936 for their association activities, which are done through the medium of committees and various associations. This included work done in connection with the exchange of equipment and the repair and return thereof, including payment for the use of cars delivered to other railroads in exchange; the research work of the associations in the field of equipment and operating methods; formulation of rules for the transportation of explosives and other dangerous articles; the work of demurrage and storage bureaus, which have to do with the making of demurrage rules and the collection of demurrage; investigation and work done for fire protection; and the work of the traffic bureaus, having to do with the investigation of rates and the publication of tariffs. As a matter of fact, over these years the work of the Association of American Railroads, the Association of Railway Executives, the law department of the A. A. R., and the state railroad associations, has not cost more than $8,000,000, and of this only a very small proportion was expended in legislative work, national and state, consisting principally of bills for printing and clerical help and postage. Considering the great amount of money that has been appropriated for the T. N. E. C. and the amount of misinformation it is disseminating, it might be well for the taxpayers associations to look into its activities and check up on its expenditures and the type of so-called "experts" it is using.

(*Turn to second left-hand page*)

NEWS

First Alco-Built Combat Tank Accepted by U. S. Army

On April 19 the first of 685 medium (M-3) combat tanks ordered on November 23, 1940, were tested and turned over, with appropriate ceremonies, to the United States Army by the American Locomotive Company at its plant at Schenectady, N. Y. The tank, built up of armor riveted together, has an overall length of 18 ft. and is over 8 ft. in height and weighs about 28 tons. It is made up of more than 14,000 parts, is armed with machine guns and 75- and 37-mm. cannon, and has a heavily armored rotating turret on top. It is driven by a 400-hp. fan-cooled gasoline engine of radial, aircraft type, located in the rear and is said to be capable of a sustained speed of upwards of 25 miles an hour. Steering is accomplished by hydraulic brakes.

The actual weight of the tank is carried on extraordinarily flexible wheel suspensions, three on each side. Each suspension is supported by two solid rubber-tired wheels and the angle of movement of each pair of wheels is such as to permit the track underneath to bend over practically any obstacle which might be encountered.

In preparing for the building of these tanks many extensive alterations had to be made at the Schenectady plant of the American Locomotive Company. Thousands of square feet of floor space was diverted from the manufacture of locomotives and rearranged for efficient and rapid assembly line production of combat tanks. More than two hundred new machine tools had to be ordered, received and installed, and existing machine tools had to be relocated. Over 2,500 different drawings had to be processed. Three hundred and fifty orders for materials were placed; engines, accessories, transmissions, etc., had to be supplied by the government in addition to armor plate and guns, and many hundred workmen had to be hired and specially trained.

In accepting the tank for the United States Government, Robert P. Patterson, under secretary of war, said: "The record speed of the completion of this tank, fabricated by a commercial facility from new drawing to complete tank again demonstrates the genius of American industry: (1) skilled loyal workmen; (2) trained, energetic leaders in the shop and mill; (3), intelligent, efficient, honest, driving management, and (4) the keen desire of organizations such as the American Locomotive Company to throw their experienced facilities into the job of turning out that which we need for our national defense in record time with high efficiency."

The first of 685 medium combat tanks which are being built by the American Locomotive Company for the United States Army

New Passenger Car Wheel Developed by Armco

A new high-speed passenger-car wheel especially resistant to internal stresses developed in service has been announced by W. W. Sebald, vice-president, American Rolling Mill Company, Middletown, Ohio. The chief factor in the five years of research preceding its production was a testing-machine developed by the company which made it possible to simulate the effect of thousands of actual service miles within several hours. This machine can produce complete failure of wheels due to breaking through the rim and plate as in actual service.

To achieve a wheel having resistance to both low initial stresses and cumulative service stresses, engineers of the company first made metallograph-studies of wheels in service to determine the cause of thermal cracking. They then made a laboratory test on the machine mentioned above of the behavior of every analysis of steel used or proposed for passenger-car wheels. By these methods a composition of steel possessing the properties desired was determined.

Equipment Purchasing and Modernization Programs

Chicago & North Western.—The C. & N. W. has awarded a contract to the H. A. Peters Company, Chicago, for the construction of a one-story machine shop addition 100 ft. by 150 ft. at Green Bay, Wis. The new structure will have a steel frame and brick walls, and a 15-ton traveling crane and two track drop table pits will be installed. The cost of the improvements will be approximately $82,000.

The Chicago, Rock Island & Pacific.—The Rock Island has been authorized by

(*Continued on next left-hand page*)

Orders and Inquiries for New Equipment Placed Since the Closing of the April Issue

Locomotive Orders

Road	No. of Locos.	Type of Locos.	Builder
Atchison, Topeka & Santa Fe	1	5,400-hp. Diesel-elec. frt.	Electro-Motive Corp.
Baltimore & Ohio	4	4,000-hp. Diesel-elec. pass.	Electro-Motive Corp.
Central of Georgia	1	1,000-hp. Diesel-elec.	Baldwin Loco. Wks.
	1	660-hp. Diesel-elec.	
Chicago & North Western	3[1]	660-hp. Diesel-elec.	American Loco. Co.
	3[1]	350-hp. Diesel-elec.	Whitcomb Loco. Co.
Chicago, Burlington & Quincy	5	44-ton Diesel-elec.	Davenport-Besler Corp.
Chicago, Milwaukee, St. Paul & Pacific	1[2]	4,000-hp. Diesel-elec.	Electro-Motive Corp.
	1	5,400-hp. Diesel-elec. frt.	
	1	600-hp. Diesel-elec.	
	2	1,000-hp. Diesel-elec.	American Loco. Co.
	1[3]	4,000-hp. Diesel-elec.	
	2	44-ton Diesel-elec.	Davenport Besler Corp.

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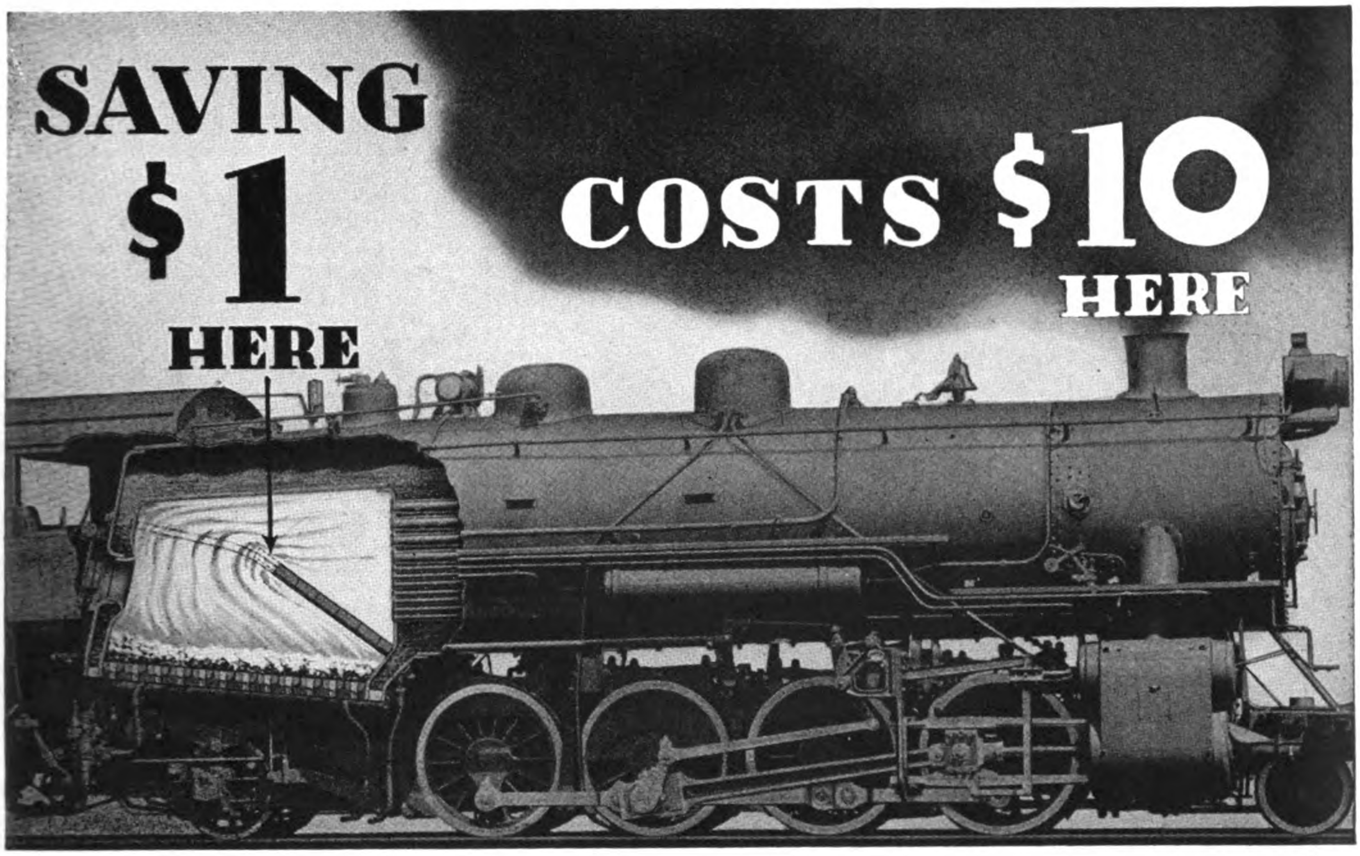

cut down on the arch and you boost the fuel bill

No one questions locomotive Arch economy. The Arch has been so thoroughly proved as a fuel saver by railroad after railroad for years past.

In the urge for money saving don't let the desire to save a few dollars in Arch brick expense, by skimping on the Arch, blind you to the fact that every dollar thus "saved", boosts the fuel bill ten dollars.

The surest way to the lowest operating cost is not in crippling proved economy devices but in making full use of them. This means complete Arches, with every brick in place, for each locomotive that leaves the roundhouse.

HARBISON-WALKER REFRACTORIES CO.
Refractory Specialists

AMERICAN ARCH CO.
INCORPORATED
60 EAST 42nd STREET, NEW YORK, N. Y.
Locomotive Combustion Specialists

Chicago, Rock Island & Pacific	2	2,000-hp. Diesel-elec.	Electro-Motive Corp.
	1	2,000-hp. Diesel-elec.	American Loco. Co.
	5	30-ton Diesel-mech.	Davenport Besler Corp.
Day & Zimmerman, Inc.	1	1,000-hp. Diesel-elec.	Baldwin Loco. Wks.
	1	650-hp. Diesel-elec.	
Denver & Rio Grande Western	1	1,000-hp. Diesel-elec.	Electro-Motive Corp.
Detroit, Toledo & Ironton	2	600-hp. Diesel-elec.	Electro-Motive Corp.
Dewey Portland Cement Co.	1	44-ton Diesel-mech.	Davenport Besler Corp.
Great Lakes Steel Co.	2	600-hp. Diesel-elec.	Electro-Motive Corp.
Minnesota Transfer Ry.	3	360-hp. Diesel-elec.	American Loco. Co.
Newfoundland Ry.	1	2-8-2	Montreal Loco. Wks.
Norfolk & Western	6	Mallet	Co. shops
Pennsylvania	1	1,000-hp. Diesel-elec.	Electro-Motive Corp.
Pickands, Mather & Co.	1	0-8-0	Baldwin Loco. Wks.
St. Louis-San Francisco	2	44-ton Diesel-elec.	Davenport-Besler Corp.
Terminal R. R. Assn. of St. Louis	3	1,000-hp. Diesel-elec.	American Loco. Co.
	2	1,000-hp. Diesel-elec.	Baldwin Loco. Wks.
	3	1,000-hp. Diesel-elec.	Electro-Motive Corp.
United States Navy Dept.	3	300-hp. Diesel-elec.	H. K. Porter Co.

Freight-Car Orders

Road	No. of Cars	Type of Car	Builder
Aliquippa & Southern	50	L. S. Gondolas	Co. shops
Atchison, Topeka & Santa Fe	1,000	50-ton box	Pull.-Std. Car Mfg. Co.
	500	50-ton auto	
	200	50-ton gondola	Gen. Amer. Trans. Corp.
	50	Steel Caboose	Co. shops
Baltimore & Ohio	50[3]	70-ton cement	Greenville Steel Car Co.
	23	70-ton gondolas	Bethlehem Steel Co.
Bethlehem Steel Co.	12	100-ton flat	Co. shops
	3	200-ton ingot	
Central of Georgia	100	50-ton box	Pull.-Std. Car Mfg. Co.
	100	50-ton auto	
Chesapeake & Ohio	400	50-ton hoppers	American Car & Fdry. Co.
	300	50-ton hoppers	Gen. Amer. Trans. Corp.
	300	50-ton hoppers	Pull-Std. Car Mfg. Co.
Chicago, Indianapolis & Louisville	60	50-ton flat	Pull.-Std. Car Mfg. Co.
	150	50-ton box	
Chicago, Milwaukee, St. Paul & Pacific	500	50-ton box	[4]Co. shops
	25	Caboose	
	6	100-ton flat	
Chicago, Rock Island & Pacific	25	70-ton covered hopper	Gen.-Amer. Trans. Corp.
Delaware & Hudson	5	100-ton well	Co. shops
Erie	800	50-ton box	Pull.-Std. Car Mfg. Co.
	100	50-ton furniture	American Car & Fdry. Co.
	100	50-ton auto-box	
	50	70-ton covered hopper	
	250	50-ton hopper	Gen. Amer. Trans. Corp.
	250	70-ton gondolas	Greenville Steel Car Co.
	50	70-ton flat	
General Electric Co.	1	70-ton covered hopper	American Car & Fdry. Co.
Illinois Central	1,000[5]	50-ton hopper	Pull.-Std. Car Mfg. Co.
	500[5]	40-ton box	Gen. Amer. Trans. Corp.
	200[5]	40-ton refrig.	
	100[5]	70-ton covered hoppers	
	500[5]	40-ton box	American Car & Fdry. Co.
	100	50-ton flat	
Lake Superior & Ishpeming	100[6]	50-ton ore	Bethlehem Steel Co.
Louisville & Nashville	500	50-ton hopper	American Car & Fdry. Co.
	500	50-ton box	
	500	50-ton hopper	Pullman-Std. Car Mfg. Co.
	600	50-ton box	
Minneapolis & St. Louis	50	50-ton box	Pull.-Std. Car Mfg. Co.
Montour	300	50-ton hopper	Pull.-Std. Car Mfg. Co.
Nashville, Chattanooga & St. Louis	200	50-ton hopper	Pull.-Std. Car Mfg. Co.
New York Central	1,000	50-ton box	Despatch Shops, Inc.
	1,000	50-ton gondolas	
New York, Chicago & St. Louis	500	50-ton box	American Car & Fdry. Co.
Pennsylvania	50	90-ton container	Co. shops
Reading	500	H. S. gondolas	Co. shops
Southern Pacific	50	70-ton H. S. gondolas	American Car & Fdry. Co.
U. S. Navy	1	Flat	Greenville Steel Car Co.
U. S. Navy Dept.	6	70-ton flat	Haffner-Thrall Car Co.
Wheeling & Lake Erie	500	50-ton hopper	American Car & Fdry. Co.

Freight-Car Inquiries

Road	No. of Cars	Type of Car	Builder
Chicago, Rock Island & Pacific	1,000[7]	50-ton box	....
Norfolk & Western	500-1,000	40-ft.-6-in. 50-ton box	....
	200-500	50-ft.-6-in. 50-ton box	....
Southern Pacific	2,000	Flat	....
Missouri Pacific	100[8]	50-ton auto parts	....

Passenger-Car Orders

Road	No. of Cars	Type of Car	Builder
Atchison, Topeka & Santa Fe	2	Diners	Edw. G. Budd
	1	Lunch-counter-diner	
	5	Mail-bagg.	
	14	Mail-storage	
Chicago, Milwaukee, St. Paul & Pacific	8	Taproom	Co. shops
	8	Coaches	
	2	Coach-baggage	
	2	Diners	
	6	Parlor	
Norfolk & Western	35	Chair[9]	Pullman Co.

[1] Purchase authorized by court. Cost of six locomotives, $289,150.
[2] For use on the Hiawatha.
[3] Order unconfirmed.
[4] Reported in the April issue under Equipment Purchasing and Modernization Program.
[5] The 2,300 freight cars will cost $7,400,000.
[6] In addition to the 100 ore cars ordered in February and reported in the March issue.
[7] Purchase, at a cost of $2,700,000, authorized by Federal District Court.
[8] Inquiry renewed.
[9] These are used all-steel Pullman chair cars which will be converted into passenger coaches. Ten of the cars will be converted by the railroad in its shops and 25 by the Pullman-Standard Car Manufacturing Company. Each reconditioned car will be equipped with 43 walk-over type seats and will have a seating capacity of 86 persons. An electric water cooler, wash basin, and other conveniences will be located at each end of the cars.

the district court to purchase $1,175,000 of equipment as follows: three 2,000-hp. Diesel-electric locomotive ($525,000); five stainless-steel coaches ($350,000); two dining cars ($180,000), and two stainless-steel combination mail-express-baggage cars ($120,000). According to E. M. Durham, Jr., chief executive officer, the new equipment is necessary because of substantially increased patronage of the Rock Island's 15 Rocket trains. Purchase of the three locomotives is reported elsewhere in this issue.

Erie.—The Erie is reported to be contemplating the acquisition of five express cars.

Kansas City Southern.—The K. C. S. is reported to be in the market for from 200 to 225 freight cars comprising 100 box cars of 50 tons' capacity, 50 automobile cars of 50 tons' capacity and 50 to 75 gondola cars of 70 tons' capacity.

Reading.—The Reading has been authorized by the company's board of directors to purchase ten Diesel-electric switching locomotives comprising 2 of 1000 hp., 5 of 600 hp. and 3 of 660 hp.

Union Pacific.—The Union Pacific, to meet its requirements for 500 stock cars, will rebuild and convert certain cars in its own shops.

Author of "Grimshaw's Locomotive Catechism" Dies at 91

Dr. Robert Grimshaw, noted inventor and engineer in the mechanical field, died at Englewood, N. J., on April 9 at the age of 91. Dr. Grimshaw retired at the age of 82 following a career of 60 years in mechanical engineering, during which time he developed a number of technical improvements in the railroad industry. He was also a prolific writer on engineering subjects and was the first editor of the magazine "Power."

His principal writing in the railroad field is the "Locomotive Catechism" which ran through 30 editions, the last being dated 1923. This work is a 958-page handbook of questions and answers concerning practical operation and maintenance of the steam locomotive. Dr. Grimshaw was one of the founders of the American Society of Mechanical Engineers in 1880 and a member of a number of professional societies abroad.

Equipment Depreciation Orders

Equipment depreciation rates for four railroads, including the Illinois Central, have been prescribed by the Interstate Commerce Commission in a new series of sub-orders and modifications of previous sub-orders in No. 15100, Depreciation Charges of Steam Railroad Companies.

Prescribed rates for the I. C. are as follows: Steam locomotives, 3 per cent; electric switchers, 2.82 per cent; Diesel-electric switchers, 3.92 per cent; Diesel-electric road locomotives, 6 per cent; freight train cars, 4 per cent; articulated streamlined passenger train, 8.14 per cent; non-articulated streamlined passenger train, 3.84 per cent; Diesel rail motor cars, 4.85 per cent; all other passenger-train cars, 2.75 per cent; floating equipment, 2.5

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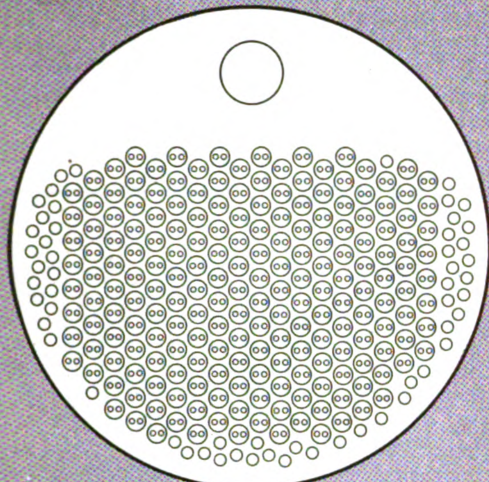
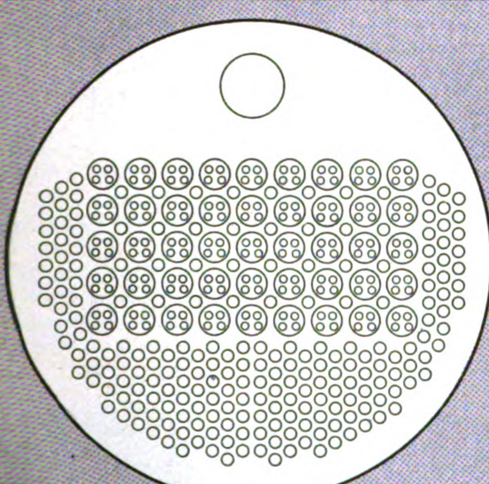
Maximum Boiler Horsepower



Boiler With a Type "E" Superheater

ITEM	SUPERHEATER Type "A"	Type "E"	Increase	Increase Per Cent
Tube and flue heating surface...	4,200 sq. ft.	4,641 sq. ft..	441 sq. ft.	10.5
Superheating surface	1,164 sq. ft.	2,088 sq. ft.	924 sq. ft.	79.3
Gas area	1,337 sq. in.	1,374 sq. in.	37 sq. in.	2.76
Steam area	51.3 sq. in.	67.06 sq. in.	15.76 sq. in.	30.7



Boiler With a Type "A" Superheater

The steam generating capacity of a boiler is directly proportional to the amount of evaporating surface in square feet for equal length of tubes.

The tabulation compares two typical boilers in actual service, with the same outside diameter and length, as illustrated, one designed for the Type "E" superheater and the other for the Type "A" superheater.

The increase in evaporating and superheating heating surfaces made possible with the Type "E" superheater design in the same size of boiler, is substantial and is responsible for an increase in the steam generating capacity of the boiler.

Specify boilers with Elesco Type "E" superheaters for maximum boiler horsepower.

ELESCO

SUPERHEATERS • FEEDWATER HEATERS
AMERICAN THROTTLES • STEAM DRYERS
EXHAUST STEAM INJECTORS • PYROMETERS

THE SUPERHEATER COMPANY

Representative of
AMERICAN THROTTLE COMPANY, INC.
60 East 42nd Street, NEW YORK
122 S. Michigan Ave. CHICAGO
• • •
Montreal, Canada
THE SUPERHEATER COMPANY, LTD.

per cent; work equipment, 3.5 per cent; miscellaneous equipment, 12 per cent. The other three roads involved in the present series of orders are the Donora Southern; Genesee & Wyoming; and Lake Erie, Franklin & Clarion.

Rail Employees Advised to File Service Statements

About 300,000 present and former railroad employees who have not yet furnished statements of the railroad service they rendered before 1937 have been advised by the Railroad Retirement Board to file them with the Board or at a railroad office as soon as possible if they wish to avoid delay in getting their annuities at the time they retire and want to help make sure that the necessary records of their pre-1937 service are not lost or destroyed in the future.

In a message directed to these employees, many of whom are not now working for a railroad but who nevertheless have credits toward annuities based in whole or in part on service in the railroad industry before 1937, the Board states: "Your service in the railroad industry before 1937 may be creditable toward your annuity under the Railroad Retirement Act. Under a nation-wide program [the prior service records project] recently authorized by Congress the amount creditable to you for that service can now be determined by the Board in advance of your retirement if you will state when, where, and for whom you worked, so that your railroad employers can furnish the Board with a record of your service and compensation."

Supply Trade Notes

Walter Davis has been appointed west coast representative of the Graham-White Sander Company of Roanoke, Va.

◆

George H. Snyder, sales agent in charge of the St. Paul, Minn., office of the American Steel Foundries, Chicago, has been appointed general sales manager, railway division, with headquarters at Chicago. Mr. Snyder entered railway service in 1905 in the stores department of the Minneapolis, St. Paul & Sault Ste. Marie and in 1911 was transferred to the office of the general mechanical superintendent. He resigned from the M. St. P. & S. S. M. in 1920 to enter the sales department of the American Steel Foundries at St. Paul, and since 1935 has been sales agent in charge of that office.

George H. Snyder

◆

James M. Brophy has been appointed sales representative of the Chicago Railway Equipment Company, Chicago.

◆

American Chain & Cable Co.—*J. E. Skinner* has been placed in charge of welding wire sales, as assistant to W. H. Bleecker, sales manager, at the general sales office of the Page Steel & Wire division, American Chain & Cable Co., Inc. He succeeds *V. H. Godfrey,* who has been called to active duty with the United States Navy. *W. H. Hoagland* of the Chicago office of the Page Steel & Wire division has been transferred to Monessen, Pa., to assume the duties previously handled by Mr. Skinner.

Pittsburgh Plate Glass Company.—*Robert L. Clause,* executive vice-president of the Pittsburgh Plate Glass Company, Pittsburgh, Pa., has been elected president to succeed *H. S. Wherrett,* who has been elected to the newly created office of vice-chairman of the board.

◆

The American Rolling Mill Company is building a new $5,000,000 blast furnace, at the Ashland, Ky., division. Construction began March 12, and is expected to be completed in about one year. Daily operation will require about 1,950 tons of ore, 935 tons of coke, 485 tons of limestone, 125 tons of mill scale and open hearth slag.

◆

American Car & Foundry Company.—At the St. Louis plant of the American Car and Foundry Company a new car paint-shop has recently been placed in service. It contains eight railroad tracks, and accommodates 115 freight cars at one time. Designed for year-round operation, 30 overhead unit heaters will maintain a comfortable 65 deg. F. even in zero weather. The building is 660 ft. long, 130 ft. wide, and contains 86,000 sq. ft. of concrete flooring. Daylight illumination is supplied by 22,000 lights of glass in the walls and in the Aiken type monitor roof, and the electrical illumination is from incandescent lamps in enclosed angle-type reflectors. The two 64-ft. trusses which support the roof give a working clearance of 20 ft. and the entire floor area is free except for one central row of steel columns.

M. A. Foss, service engineer of the Locomotive Firebox Company, Chicago, has been appointed assistant vice-president, with headquarters in New York. He will assume the duties in the Eastern territory formerly performed by George N. DeGuire deceased. Mr. Foss received his early training in the employ of the Bath Shipbuilding Company, Bath, Me., and was in charge of the boiler department of that company from 1917 to 1921. In the latter year, he became supervisor of boilers and maintenance of the New York, New Haven & Hartford, and in 1929 entered the employ of the Locomotive Firebox Company as service engineer.

M. A. Foss

New car paint-shop placed in service in American Car and Foundry's St. Louis plant

E. P. BARNETT has joined the Hunt-Spiller Manufacturing Corporation of Boston, Mass., as sales representative in the southeast territory assisting F. B. Hartman. Mr. Barnett had been assistant mechanical engineer on the Southern from 1935 to 1940 and, during the past year was a special engineer on the Chicago, Indianapolis & Louisville.

◆

AMERICAN CAR AND FOUNDRY CO.—*Thomas A. Dooley* has been appointed district manager in charge of the Madison, Wis., and St. Louis, Mo., car plants of the American Car and Foundry Company which have been combined under the one management. *Norman H. Shipley* will act as assistant district manager of the Madison car plant.

◆

HARRY E. ORR, for the past seven years chief metallurgist of the Burnside Steel Foundry Company of Chicago, has been appointed sales engineer of the Vanadium Corporation of America, with headquarters at the company's Chicago office.

◆

FRANK S. WILLIAMS has been placed in charge of eastern sales for the Wilson Engineering Corporation, Chicago, with headquarters at Providence, R. I. Since graduation from Yale University in 1914 he completed a special apprenticeship course in the shops of the Colorado & Southern and has served the Union Pacific, the Denver & Rio Grande Western and the Chicago, Rock Island & Pacific as transportation inspector.

Obituary

FRED J. WILSON, who until his retirement in 1935 had handled sales of the locomotive equipment division of Manning, Maxwell & Moore, Inc., on the Pacific coast, died April 3 at his home in Alhambra, Cal.

Personal Mention

General

DEAN F. WILLEY, mechanical superintendent of the New York, New Haven & Hartford, with headquarters at New Haven, Conn., has been appointed general mechanical superintendent, succeeding Albert L. Ralston, deceased.

Master Mechanics and Road Foremen

FRED L. CARSON, master mechanic on the Southern Pacific Lines in Texas & Louisiana at San Antonio, Tex., has retired.

L. J. GALLAGHER, general master mechanic on the Northern Pacific, Western district, with headquarters at Seattle, Wash., has retired.

H. H. JONES, assistant to the superintendent of motive power and machinery of the Union Pacific at Pocatello, Idaho, has been appointed master mechanic at Los Angeles, Calif.

P. T. BRIERS, master mechanic of the Cincinnati division of the Chesapeake & Ohio, at Stevens, Ky., has been transferred to the Richmond (Va.) division, to succeed J. S. Williams, deceased.

GRANT W. STANTON, traveling engineer of the Minneapolis, St. Paul & Sault Ste. Marie, has been promoted to master mechanic, with headquarters as before at Minneapolis, Minn.

ARTHUR H. FIEDLER, master mechanic on the Northern Pacific at Jamestown, N. D., has been appointed general master mechanic, Eastern district (Lines east of Livingston, Mont.), with headquarters at St. Paul, Minn.

G. L. ERNSTROM, general master mechanic on the Northern Pacific, Eastern district (Lines east of Livingston, Mont.), at St. Paul, Minn., has been transferred to the Western district, with headquarters at Seattle, Wash.

JESSE A. CANNON, road foreman of engines on the Northern Pacific at Minneapolis, Minn., has been promoted to the position of master mechanic at Jamestown, N. D.

J. E. GOODWIN, general foreman of the locomotive shop on the Missouri Pacific at North Little Rock, Ark., has been appointed master mechanic on the International-Great Northern (Missouri Pacific) with headquarters at San Antonio, Tex. Mr. Goodwin was born May 13, 1902, at Topeka, Kans., and attended high school at Newton, Kans., and received his technical education at Lake Forest University and the University of Chicago. He entered railway service in June, 1917, with the Atchison, Topeka & Santa Fe at Newton as a messenger. After having served his apprenticeship in the locomotive shop with the Santa Fe, Mr. Goodwin became machinist in January, 1922, from which position he resigned to enter college. In June, 1925, he joined the Missouri Pacific at Hoisington, Kans., as a machinist and in March, 1926, was transferred to Horace, Kans., as enginehouse foreman. In November, 1927, he became erecting foreman at North Little Rock, Ark., November, 1929, schedule supervisor; December, 1930; general foreman, November, 1933; and served in this capacity until appointed to his present position.

J. E. Goodwin

C. D. ALLEN, assistant master mechanic on the Chesapeake & Ohio at Clifton Forge, Va., has been promoted to master mechanic of the Cincinnati division, with headquarters at Stevens, Ky.

PAUL E. LEONARD, enginehouse foreman on the Southern Pacific Lines in Texas & Louisiana at Beaumont, Tex., has been promoted to master mechanic at San Antonio, Texas.

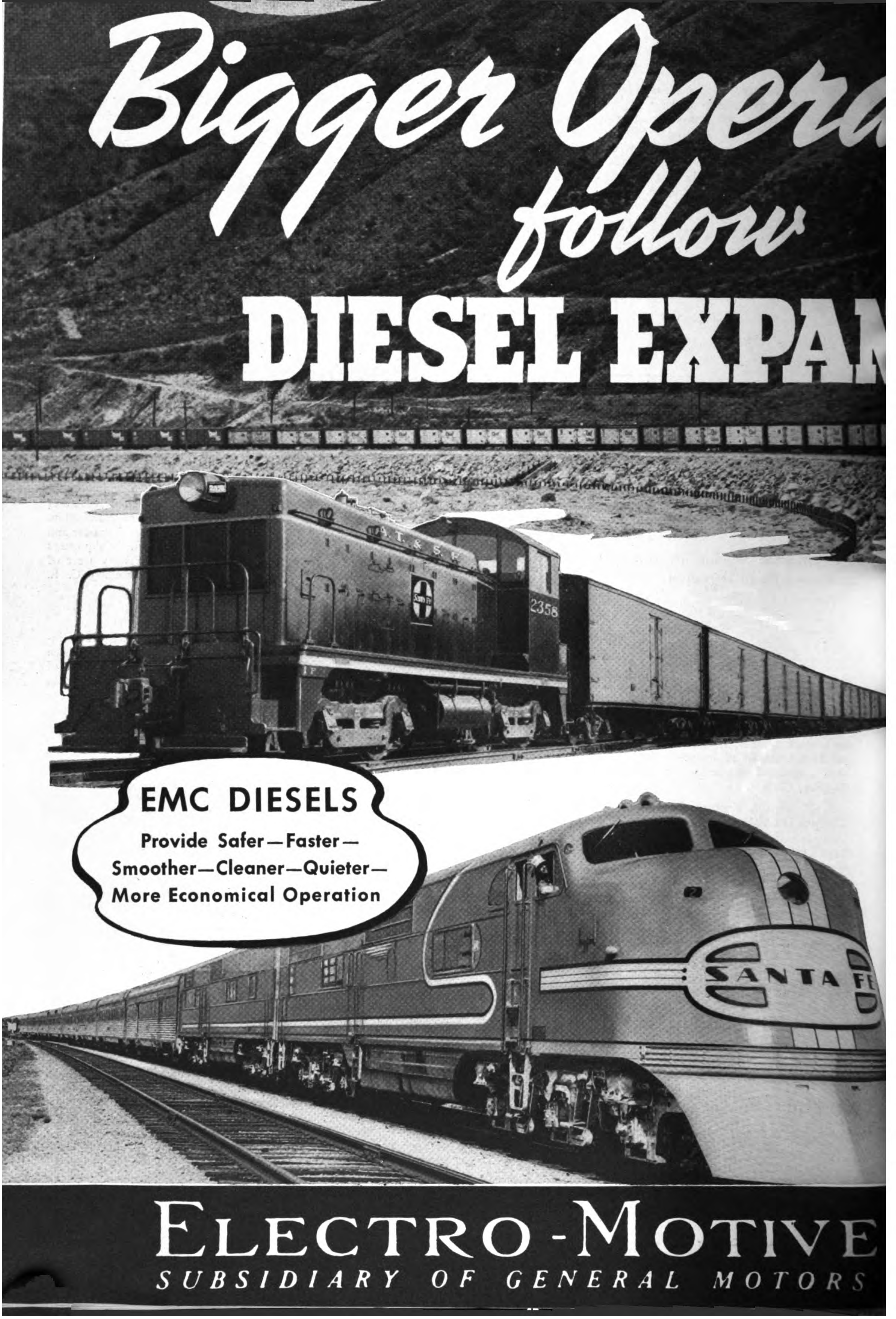
J. J. CALLAHAM, road foreman of engines on the Chesapeake & Ohio at Huntington, W. Va., has been appointed trainmaster and road foreman of engines, with headquarters at Huntington, covering territory west of Peach Creek, W. Va., succeeding C. L. Gilmore, retired.

Car Department

FRANK E. CHESHIRE, general car inspector, Missouri Pacific, who has been promoted to the newly created position of assistant superintendent car department, as announced on page 168 of the April issue of the *Railway Mechanical Engineer*, was born on April 27, 1898, at Cumberland, Md. Mr. Cheshire attended the Keyser W. Va., high school, Potomac State College, and Davis-Elkins College. He entered railway service on May 28, 1915, with the Baltimore & Ohio. In June, 1916, he enlisted in the Army holding warrants as corporal, sergeant and sergeant first-class. He was commissioned second lieutenant in August, 1918, and first lieutenant in September, 1918. In July, 1919, he resigned, and in

Frank E. Cheshire

(*Continued on second left-hand page*)


Bigger Oper
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January, 1920, returned to the B. & O., serving subsequently as car builder, car inspector, work checker, traveling car repair accountant, shop foreman, and car foreman. He was with the Ford Motor Company for a few weeks in 1926, in July of which year he entered the service of the Missouri Pacific as assistant general car inspector. On July 1, 1927, he became general car inspector. Mr. Cheshire is active in American Legion activities having served four terms as post commander, district commander and department chairman on Americanism. He holds a commission as major, Engineers Corps Reserve, assigned to headquarters, Military Railway Service. He is a past president and chairman, Executive Committee, of the Car Department Officers' Association of St. Louis. Mr. Cheshire is now vice-president of the Car Department Officers' Association.

J. B. HARMISON has been appointed division car foreman on the Erie with headquarters at Jersey City, N. J.

C. W. GRAHAM, car shop superintendent of the Wabash, has been appointed assistant superintendent of the car department, with headquarters as before at Decatur, Ill.

O. A. WALLACE, general car foreman of the Atlantic Coast Line, with headquarters at Wilmington, N. C., has been appointed superintendent of the car department.

J. M. HOLT, general car inspector of the Southern Pacific (Pacific lines), has been promoted to general master car repairer, a newly created position, with headquarters as before at San Francisco, Cal.

Shop and Enginehouse

W. A. NEWMAN, general foreman on the Chicago, Burlington & Quincy at Denver, Colo., has been promoted to assistant superintendent of shops, a newly created position, with headquarters at West Burlington, Iowa.

Purchasing and Stores

FRANK CARY HOLTON, assistant superintendent of motive power of the Virginian at Princeton, W. Va., has been appointed purchasing agent with headquarters at Roanoke, Va. Mr. Holton was born on December 19, 1896, at Danville, Va., and was educated at the Danville elementary school, Danville Military Institute, Virginia Polytechnic Institute and Cornell University (1918). During the summers of 1910 to 1913, Mr. Holton served as a machinist apprentice on the Southern at Danville and during the summers of 1914 to 1918, was a machinist apprentice on the Norfolk & Western at Roanoke, Va. He became an ensign in the United States Navy in 1918, and in 1919 returned to Roanoke as a machinist on the Norfolk & Western. He entered the service of the Virginian in 1920 as mechanical inspector and enginehouse foreman at Princeton, W. Va. Mr. Holton was appointed chief draftsman at Princeton in 1924, mechanical engineer in 1927, and assistant superintendent of motive power in 1938.

Obituary

ALBERT L. RALSTON, general mechanical superintendent of the New York, New Haven & Hartford, with headquarters at New Haven, Conn., died on April 3 in Pinehurst, N. C., where he was on vacation. Mr. Ralston was born at Amo, Ind., on April 10, 1883, and was graduated from Purdue University in June, 1905, following which he took a special apprenticeship course with the Westinghouse Electric & Manufacturing Company at Pittsburgh, Pa., specializing in railroad work. During 1906 and the early part of 1907 he worked in the engineering department of Westinghouse on the development of design and construction of the first electric locomotive built for the New Haven, then being assigned by Westinghouse to Stamford, Conn., where he remained until 1914. Mr. Ralston entered the service of the New York, New Haven & Hartford as assistant electrical engineer in May, 1914, and in February, 1915, was appointed assistant to the mechanical superintendent in charge of the maintenance of electric equipment. In May, 1917, he became engineer of electric traction, with headquarters at Grand Central Terminal, and in September, 1918, he was promoted to mechanical superintendent in charge of maintenance of electric equipment, remaining in that position until his promotion to assistant general mechanical superintendent at New Haven on November 1, 1932. Mr. Ralston was promoted to general mechanical superintendent in July, 1934.

Albert L. Ralston

Trade Publications

Copies of trade publications described in the column can be obtained by writing to the manufacturers. State the name and number of the bulletin or catalog desired, when it is mentioned.

ARC WELDING.—The Hobart Brothers Company, Troy, N. Y. "Arc Welding Manual and Operator's Training Course." Price, fifty cents. Practical lessons in arc welding taken from Part II of large Hobart book, "Arc Welding and How To Use It."

◆

MECHANICAL STOKERS. — The Standard Stoker Company, Inc., 350 Madison avenue, New York. Publication No. 69—a photographic tour of The Standard Stoker Company's plant and its facilities for the manufacture of mechanical stokers for coal-burning locomotives; coal pushers for locomotive tenders, and stokers for certain types of marine use.

◆

GRINDING WHEEL DRESSING TOOLS.—Koebel Diamond Tool Co., 9350 Grinnell avenue, Detroit, Mich. "Meet Joe Green, Grinder Hand," is a four-page brochure for Management in industry which has the responsibility of furnishing men with suitable tools and teaching them their proper use. "For (Grinder) Men Only," a 28-page booklet enclosed with the brochure, is a handy wheel dressing manual for distribution among grinder operators. It tells by simple word and drawings how to handle the diamond tool so it will give maximum service and is amusingly illustrated.

◆

BUS AND CAR WASHER.—Whiting Corporation, Harvey, Ill. Eight-page illustrated bulletin. Describes Whiting line of bus and car-washing machines. Electrically operated brushes with water sprays clean the cars as they pass through the machine.

◆

TUBE EXPANDERS AND TUBE CUTTERS.—The Gustav Wiedeke Company, Dayton, Ohio. Folder 355-A shows some Wiedeke Ideal tube expanders and tube cutters for locomotive, water-tube and return-tubular steam boilers. Catalog No. 57 illustrates full line of Ideal tube expanders and cutters.

◆

UNIT TRUCK.—Unit Truck Corporation, 140 Cedar street, New York. Four page illustrated folder descriptive of Unit truck on which the customary brake hangers, brake-beam supports, and adjusting devices are replaced by integral brake-beam guides.

◆

METAL SHAPING MACHINES. — Continental Machines, Inc., 1301 Washington avenue South, Minneapolis, Minn. Spiral bound booklet containing specification sheets on various Doall contour metal-shaping machines for apprentices and those engaged in training programs.

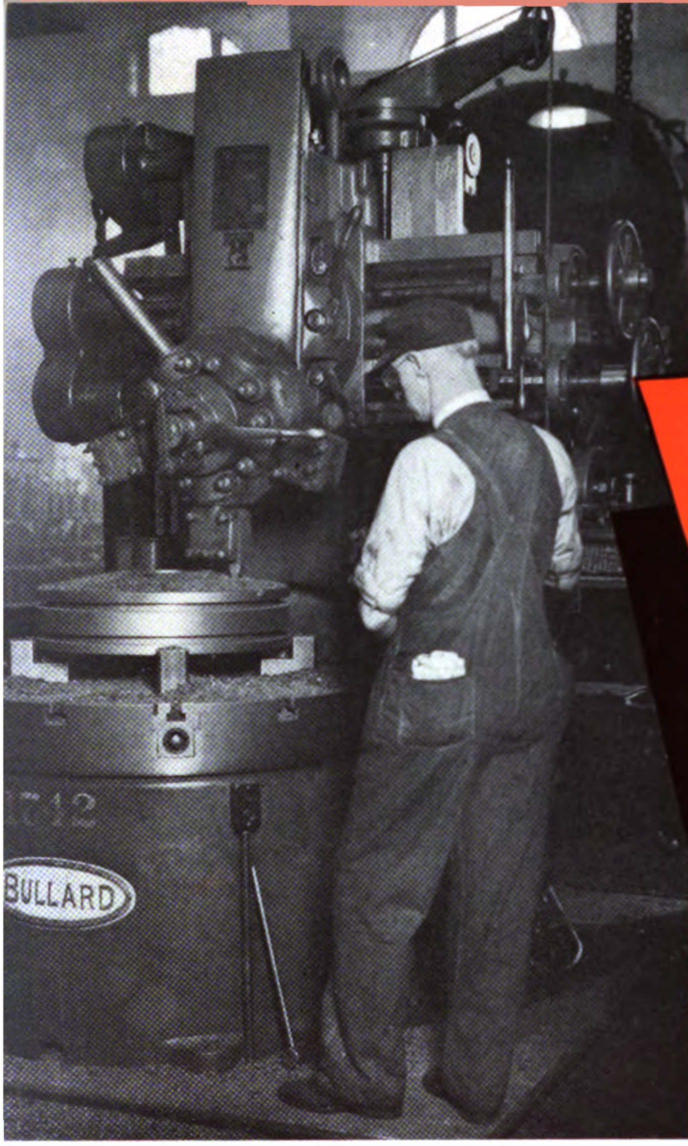
◆

FABRICATION OF STAINLESS STEELS.—Allegheny Ludlum Steel Corporation, Pittsburgh, Pa. Twenty-eight page Blue Sheet of general suggestions on the welding, machining, riveting, etc., of Allegheny stainless steels.

Railway Mechanical Engineer

June 1941

FOUNDED IN 1832



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Founded in 1832 as the American Rail-Road Journal

With which are also incorporated the National Car Builder, American Engineer and Railroad Journal, and Railway Master Mechanic. Name Registered, U. S. Patent Office.

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JUNE, 1941

Mechanical Division Meeting — June 19 and 20

(See page 217)

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IN the year which has elapsed since the last annual meeting of the Mechanical Division there has been a tremendous change in the tempo of our National Defense program. Our defense needs now so far exceed our reserve capacity of trained labor, of plants, machines and materials that we are definitely facing some rather severe curtailments in some lines of production through the exercise of priorities. Some of these priorities are affecting the railroads. How far they will continue to do so depends upon the railroads themselves—upon the extent to which railway officers believe that adequate and efficient railway transportation is an essential part of our defense program and are willing to present their cases strongly before the Division of Priorities of the O.P.M. for the procurement of an adequate supply of those essential materials for which there are no practicable substitutes. In the following pages are discussed some aspects of the present problems with respect to equipment and the labor and facilities needed for its repair.

How About Freight Locomotives?

The National Defense Program started out on a comfortable "business-as-usual" basis, with the major emphasis on fitting the emergency portion of our production and distribution into the normal portion with the least possible disturbance. In recent months it has fast been passing through a metamorphosis, from which it is emerging into something much less comfortable. And before we ever again have the privilege of thinking of our affairs in terms of the elusive "normal," they will undoubtedly have become adjusted to a most distressing abandonment of well-worn grooves of action, customary programs of production and long-cherished standards of living.

A year ago, the official attitude with respect to the transportation aspects of our defense emergency was one of complacency—that motive power and rolling stock were adequate in capacity to meet any probable demands which last year would bring. Nothing was said and apparently little thought was then given to the needs of 1941 and beyond. At that time the *Railway Mechanical Engineer* suggested that "when production schedules for armament and munitions get underway, it may be far more difficult to secure deliveries on railway motive power and rolling stock needed to meet succeeding traffic peaks, each higher than its predecessor," and suggested that difficulties of securing deliveries might very well become acute within a few months.

Now, we have a car procurement program looking ahead to 1942 and 1943, which contemplates annual car loadings of 43,680,000 in 1942 and 48,000,000 in 1943. So far, however, little has been said with respect to the motive power needed to meet these increasing traffic volumes. They represent increases of 20 per cent and 32 per cent, respectively, over the total car loadings of 1940.

If train loads are no greater during these years than in 1940, the increase in total freight locomotive miles, required to meet the increase in traffic represented by these estimates, will be of much the same order as the increase in car loadings. Assuming, however, that the average tractive force of the inventory of freight motive power will continue to increase because of the high average tractive force of the locomotives installed and the relatively low tractive force of those retired, it is probable that the average train load will continue to show an upward trend. In that case an increase of freight locomotive miles from 1940 may not be required beyond 12 to 15 per cent in 1942 and about 20 per cent in 1943.

There seems to be no reason to anticipate serious difficulty in meeting the demands of the current year. The gross ton-miles during the fall peak of 1942, however, will probably slightly exceed the gross ton-miles during the fall peak of the year 1929, and the gross ton-miles during the peak of 1943 may be as much as 15 per cent greater than in 1929. With a total locomotive mileage for the latter year less than 10 per cent below that in 1929, it seems evident that the long downward trend in the number and aggregate tractive force of freight locomotives must be reversed and that a net addition of several hundred locomotives and between 10 and 15 per cent of the present aggregate tractive force needs to be acquired during the next two and one-half years.

Transportation is a vital factor in our defense program, as well as in the normal life of the community. While the tonnage of materials required to supply the locomotives needed is not nearly as large as that required for the freight-car program, a greater variety of materials are involved, some of them under priority control. There is much less need for centralized planning in the case of locomotives than in the case of freight cars, and the matter is one for each railroad to work out for itself. It would seem the part of wisdom that any railroad which sees the need for additional freight motive power to meet the estimated demands of 1942 and 1943 should make its plans now. The more advanced knowledge of the needs of the motive power situation the builders and material producers can have, the better the prospect of the railroads for adequate consideration in the distribution of a supply which is not going to meet our needs for defense and for all our normal activities too.

National Defense And Man-Hours

If you break down the government's program for national defense and aid to Britain, it will be found that the billions of expenditures to which we are already committed, will require an almost impossible expenditure of man-hours of skilled labor during the next two years. Where is this labor to come from and still carry on and maintain essential industries? Certainly the railroads will be required to increase their activities, and the problem of maintaining the equipment under this increased tempo promises to be a most serious one.

Railroad shop labor shortages are already beginning to be felt in some few places. It is true that in one or two sections of the country and on a small number of railroads, the shopmen are not now being required to work the maximum number of hours; indeed, some men are still on furlough in a few cases. The shortages roughly about cancel the excess labor in other places, but generally speaking, shop forces at the present time have about all that they can take care of.

What about next summer and fall? Careful planning must be done to meet the situation. Steps are under way in some few places to advance the more experienced helpers or helper apprentices to journeymen and take on additional helpers, in the hope that they can be trained quickly for such work. The railroads have been more or less steadily increasing the number of apprentices, both regular and special, but here again,

the selective service draft has been operating to their disadvantage. Some railroads have asked for deferment for shop workers and, in general, the draft boards seem to have recognized the merit of this request.

Suggestions have been made looking toward the speeding up of the training programs of both the regular and helper apprentices. There has also been a tendency to shift surplus labor to neighboring railroads which were suffering a shortage. In one instance a road found that its equipment was in such excellent shape that it had a surplus of skilled workers, most of which would normally have been used for building new equipment. Lack of material prevented such operations, however, and the men have been loaned temporarily to a neighboring railroad, with the understanding that they can be called back as they are needed.

Conditions vary so greatly in different geographical sections and on different roads, that no common handling or solution can be suggested. It is a case of matching wits with conditions. Obviously, however, it may be wise in some places to institute special training measures to speed up the efficiency of new workers, whether they function as ordinary apprentices, as helpers or as mechanics taken in from the outside, or as men prematurely advanced from their apprenticeship.

A Glance at The Car Situation

The car problem now confronting the railroads resolves itself primarily into two parts, first, how to conserve and get maximum utilization from the present car supply and, second, how to get enough new cars to supplement existing equipment so that both commercial and national defense traffic can be handled without delay during the October peak and subsequently. While more or less extensive troop movements by rail will increase the demand for passenger-carrying capacity, the problem is recognized as pertaining mainly to freight equipment.

It may be said in passing, however, that substantial numbers of new passenger cars are now being turned out by the builders who already find it difficult or impossible to secure certain materials such as aluminum, both high-alloy and low-alloy steels containing nickel, and some galvanized products. The necessity of using substitute steels and other materials wherever possible is apparent. One example which might be cited is the replacement of steel interior finish, partitions and doors with composition materials or plywood, the latter in some instances being metal covered. Plastics may also be used to replace certain metal parts. The combined experience and engineering knowledge of the railroads and railway car builders will prove adequate in solving this particular problem, with one important proviso, namely, that non-nickel steels are made available to car builders in sufficient quantities so that plant production can be maintained.

Railway freight transportation is without doubt one of the most important single items in national defense and hence the vital need for an adequate supply of freight cars of the various types required and in sufficiently good condition to carry shipments quickly and safely to destination. The car building program, recently recommended by the Association of American Railroads, calls for a net increase of 120,000 cars for the anticipated traffic in 1942 and 150,000 for 1943, this equipment being in addition to the 100,000 new cars recommended about a year ago for handling the 1941 traffic. The A. A. R. is authority for the statement that the railroads will have 1,617,000 serviceable cars when the peak load of 1941 occurs in October and, of these, 168,000 will be new and 27,000 will be cars that have been rebuilt since the war broke out. This will provide the railroads with 156,000 more serviceable cars than were available for handling the business of October, 1939.

The productive manufacturing capacity of the car builders' plants has been quoted as roughly 150,000 cars annually and that of the railroads' own shops about 60,000 cars a year. The American Railway Car Institute has informed the A. A. R. that, if the car builders can succeed in increasing man-power and securing the necessary materials, they can produce up to 35,000 cars during the period October 1 to December 1, 1941, instead of 22,500 as had been previously estimated; provided orders are placed immediately for this equipment and in lots of not less than 1,000 cars of each type. (It is estimated that the car builders are booked to capacity for delivery prior to October 1.) Further, with this backlog, and running on an increasing schedule of production, a canvass of the industry indicates, if orders are placed with individual car building plants in lots of not less than 5,000 of each particular type of car required, that an additional 160,000 cars can be produced between January 1 and October 1, 1942. Obviously, this increased production is contingent upon the prompt settlement of orders and details for substantial numbers of cars of standard construction. Another helpful step would be the allocation, insofar as practicable, of individual car types to specific car building plants so as to avoid the inefficiency of split orders and frequent changes in assembly track arrangement with attendant unavoidable slow-up in production.

More than 40,000 cars are now in service in the construction of which low-alloy high-tensile steels have been employed to reduce weight. Those steels which contain nickel are no longer available for car construction. Several such steels, however, contain no nickel and to the extent that they reduce the weight, they reduce the tonnage of steel required to meet the needs of the new car program. There is good reason, therefore, why they should continue to play their part in the present car building program.

In addition to acquiring new cars, what is equally or perhaps even more important at the moment is initiating plans to secure maximum utilization of the

present car ownership. This means full cooperation between the railway operating and mechanical departments, private car companies and shippers, if desired results are to be secured. It is highly important to improve the mechanical condition of freight cars, as reflected by the percentage of bad order cars to revenue cars on line. With some individual roads reporting 10 to 15 per cent bad order cars and a national average of about 4.8 per cent, the railroads have a long ways to go in reducing this figure to about 3 per cent which it ought not to exceed.

Much can be done in reconditioning freight cars to fit them for the next higher class of loading and, in particular, working with shippers to avoid loading high-class cars with materials which prevent their further use in this class of service, at least without considerable unnecessary expense, delay and loss of car mileage. In conserving the car supply for commercial shipments, the railroads are themselves in some instances offenders, by using high-class cars for handling relatively rough company materials such as storehouse supplies, car wheels, rails, etc. This practice is particularly objectionable when the cars are not unloaded promptly but used for storage purposes, as frequently happens. Car cleaning operations, whether directly under the supervision of mechanical officers or not, should be rechecked and keyed up with a view to reducing the time on the cleaning track and hence increasing potential car miles and car days of service.

Shall We Hire Men or Machines?

The man who reads this, if he happens to have any responsibility with respect to the maintenance of equipment, hardly has to be told that events are moving rapidly around the shops and enginehouses these days. Carloadings are mounting and are already at heights that have not been reached since 1930. Out on the line the other day we dropped in on a shop supervisor that hadn't written us a letter for several months just to ask him "Why?". The answer was that these days he hardly had time to sleep for "we are putting everything through the shop that even looks like a locomotive." And there's the story of what is going on at most railroad shops.

Just by way of background here are some statistics that are of interest: In April, 1929, the Class I roads had 30,475 steam freight locomotives on line and 3,601 stored serviceable; in April, 1937, there were 24,315 on line and 1,313 stored serviceable; in April, 1939, there were 25,873 on line and 2,027 stored serviceable; in April, 1940, there were 25,024 on line and 2,131 stored serviceable and, in April 1941 there were 24,388 on line and *1,007* stored serviceable—1,594 fewer locomotives "in the bank" than we had in 1929 and yet we are heading again in the general direction of the 52.8 million carloads that the railroads hauled in that year.

It is true that there are many conditions that are decidedly different than they were in 1929. We are loading both cars and trains heavier and moving them faster. We are running freight locomotives several times the number of miles between shoppings for general repairs than was the case then. There is also the factor of the Diesel-electric freight locomotive—what it can really do when the showdown comes is yet to be seen but the indications are that it will play a very important part in the freight transportation of the immediate future.

All of these things have an important bearing on the problems that are facing the shop and the enginehouse. At this moment locomotive shop operations are about 15 per cent above the average month of 1940 and, by comparison, are about 40 per cent above the average month of 1933. By the same method of calculation the operations at present are within 10 to 12 per cent of the year 1930 and are rising all the time. From the standpoint of railroad earnings this is a situation we have been praying for for almost 10 years, and from the standpoint of the cost of shop operation we are now faced with a situation that many foresighted shop executives have feared for almost 10 years. The truth of the matter is that the time has arrived when railroad shop management is going to have a chance to find out whether or not the "penny-wise and pound-foolish" policy with respect to machine tools and shop equipment is going to be a blessing or a curse. Today our shops are actually faced with the thing we have hoped for and talked about since the days when we were at the bottom of the depression—the prospect of a demand for motive power comparable with pre-depression days. This demand when translated into shop output is about to put a tremendous load on a plant and facilities on which the railroads have spent an average of less than five million dollars a year for modernization during the past five years—five million dollars a year on plant facilities in which the investment is about 350 million dollars. These are the plants which a recent survey has shown to be surpassed only by one other industrial group in the amount of obsolete machine tools and shop equipment within their walls.

It has surprised us immensely to find out within recent months that there are a large number of railroad shop supervisors who have always thought that there was no use in asking for shop equipment because the management wouldn't buy it for them, who now think that there is no use in any railroad asking for new equipment because they couldn't get it under present conditions. The truth is they haven't asked for it, for the machinery now set up in Washington to handle their requests is still unused. If our shops fail to measure up to the job that is immediately ahead of them whose fault will it be?

The problem now is to get the men or the facilities to do the job at hand. It is up to shop managements to decide which can be secured in the shortest possible time—trained men or modern machines.

Mechanical Division Program

THE nineteenth annual meeting of the Mechanical Division, Association of American Railroads, will be held at St. Louis, Mo., on Thursday and Friday, June 19 and 20, in the main ballroom of the Jefferson Hotel. On Thursday, the meeting will convene at 9 a. m. and adjourn at 5 p. m. The Friday session will also convene at 9 a. m. and will continue until the program is completed.

Reports of 12 standing committees will be presented and discussed. In the convention calendar it is suggested that the committees limit themselves in the presentation of their reports to a brief summary of their principal features. The convention calendar also states that the Committee on Subjects will be appointed by the chairman at the opening session on Thursday, June 19, to receive questions for discussion from the members. This committee will determine whether such questions are ones suitable for discussion and, if so, will report them to the Division at the proper time for discussion by the members. Members are requested not to start discussion on subjects at the session of the meeting which have not first been referred to the Committee on Subjects.

The details of the program are as follows:

THURSDAY, JUNE 19

Address by L. W. Baldwin, president, Missouri Pacific

Address by Chairman W. H. Flynn, general superintendent motive power and rolling stock, New York Central

Action on Minutes of annual meeting of 1940

Appointment of Committee on Subjects, Resolutions, etc.

Unfinished Business

New Business

Report of General Committee

Report of Nominating Committee

Discussion of Reports on:

- Lubrication of Cars and Locomotives
- Brakes and Brake Equipment
- Couplers and Draft Gears
- Joint Committee on Utilization of Locomotives and Conservation of Fuel
- Locomotive Construction

FRIDAY, JUNE 20

Discussion of Reports on:

- Arbitration
- Prices for Labor and Materials
- Tank Cars
- Loading Rules
- Wheels
- Specification for Materials
- Car Construction
- Committee on Resolutions

Modernization of

Erie 4-6-2 Locomotives

Eleven locomotives being rebuilt with cast-steel beds—Multiple guides of the suspension type have no connection to back cylinder heads

To increase the availability and reduce the cost of maintenance of its Class K-5-A heavy passenger locomotives, the Erie is modernizing the eleven locomotives in this class by improvements consisting mainly of changes in construction. All of the locomotives have been equipped with large tenders having a capacity of 24 tons of coal and 16,000 gal. of water to facilitate operation on their assigned runs in main-line passenger service between Marion, Ohio, and Jersey City, N. J., a distance of 730 miles. Eight of the locomotives have Franklin boosters and ultimately all of them will have this equipment which produces a tractive force of 12,075 lb. The basic design of the original locomotives, as built in 1923 by the Baldwin Locomotive Works, has been retained in the rebuilt locomotives, the dimensions and proportions of which are shown in the table.

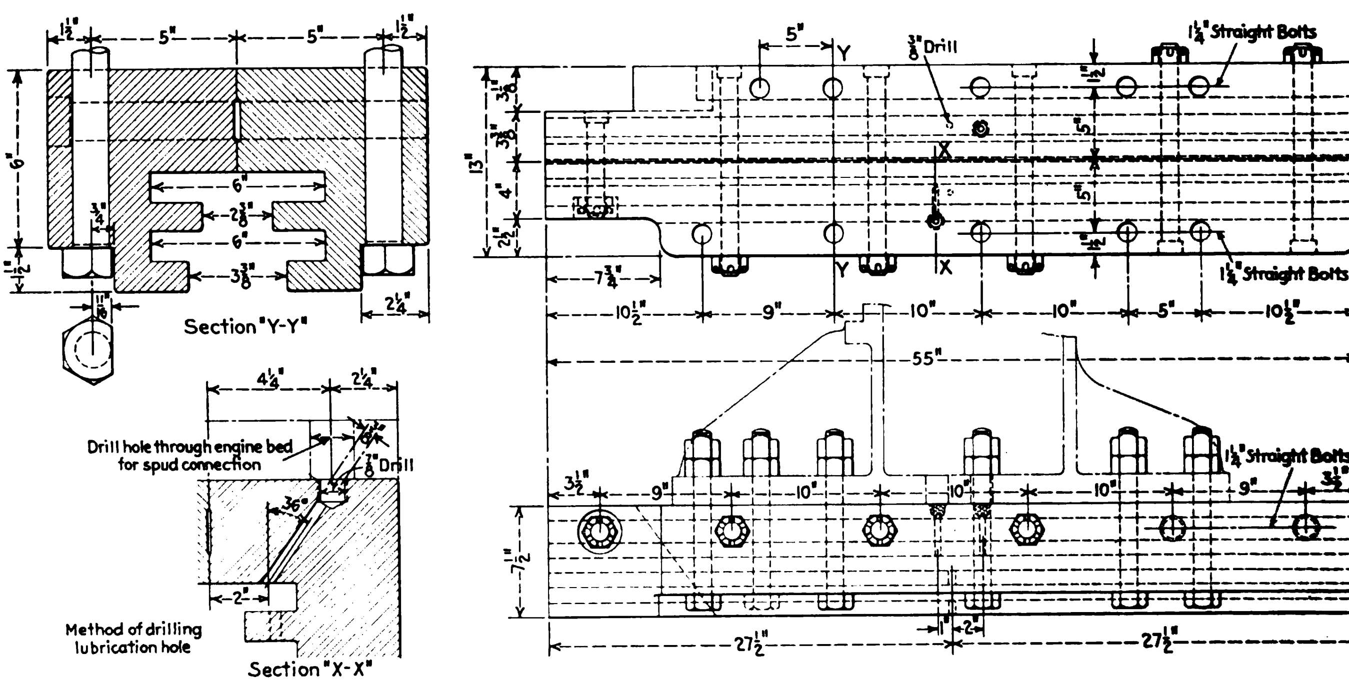
The principal construction feature is the application of one-piece engine beds with the cylinders, air-pump brackets and guide-yoke crossties cast integral which eliminates the bolting of these parts and reduces to a minimum the trouble experienced from loose bolts in the conventional built-up frames of the original locomotives. The breaking of pedestal-cap toes on the old frames has been taken care of by the strengthening of this part on the frame beds.

The design of the suspension-type multiple guides is of particular interest because it eliminates any connection between the guides and the back cylinder heads. This arrangement overcomes the trouble caused by unequal expansion when the guides were bolted to the cylinder heads. The new guides are bolted only to the guide yoke. The details of the application are shown in the drawing.

Other improvements include the use of Boxpok driving wheels and the application of Baker valve gears with Multirol needle bearings. Four of the six locomotives completed to date are equipped with Timken roller bearings on the engine-truck, driving and trailer-truck axles.

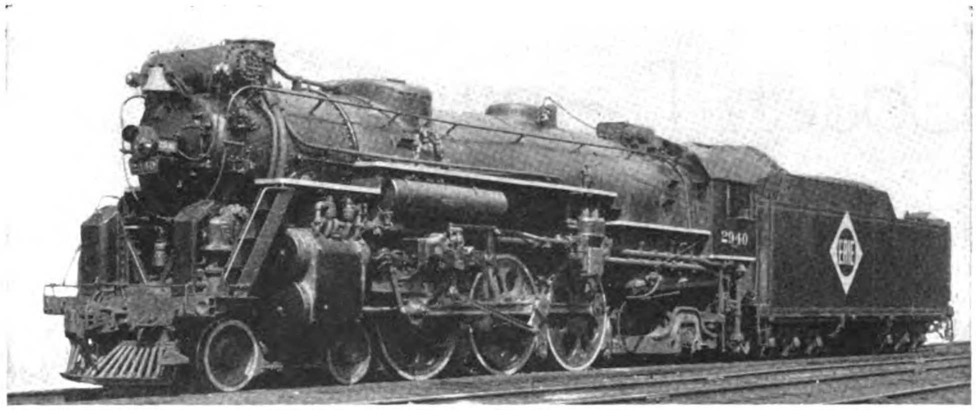
General Dimensions, Weights and Proportions of the Erie Modernized 4-6-2 Locomotives

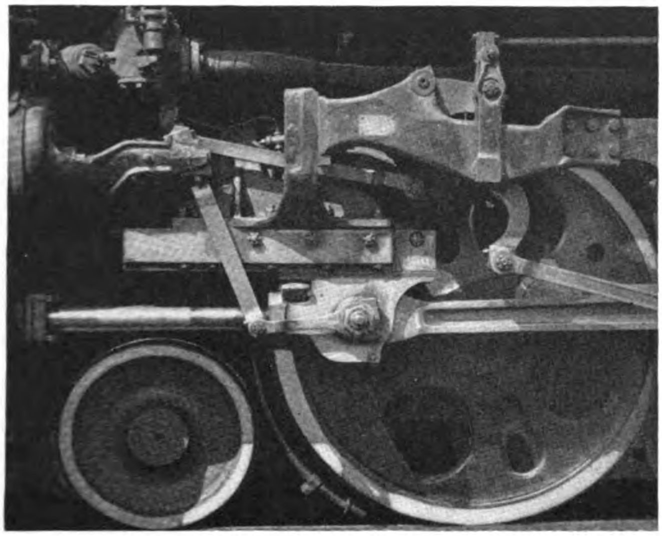
Railroad	Erie
Builder	Baldwin Loco. Wks.
Type of locomotive	4-6-2
Road class	K-5-A
Date built	1923
Service	Passenger
Dimensions:	
Height to top of stack, ft.-in.	14-11⅞
Height to center of boiler, ft.-in.	10-3
Width overall, in.	123⅜
Weights in working order, lb.:	
On drivers	205,300
On front truck	60,400
On trailing truck	66,200
Total engine	331,900
Tender	314,200
Wheel bases, ft.-in.:	
Driving	14-0
Engine, total	37-1
Engine and tender, total	80-3¾
Wheel diameter outside tires, in.:	
Driving	79



Details of the suspension-type guide showing bolting arrangement to the guide-yoke crosstie

Right: The modernized Erie 4-6-2 locomotives have the air pumps located in front of the smokebox. Below: The suspension-type guide has no connection to the back cylinder head





Front truck	36
Trailing truck	43

Engine:

Cylinder, number, diameter and stroke, in.	2-27 x 28
Valve gear, type	Baker
Valves, piston type, size, in.	14
Maximum travel, in.	7
Steam lap, in.	1¼
Exhaust clearance, in.	¼
Lead, in.	¼

Boiler:

Type	Conical
Steam pressure, lb. per sq. in.	210
Diameter, first ring, outside, in.	78
Diameter, largest outside, in.	90
Firebox length, in.	120⅛
Firebox width, in.	84¼
Arch tubes, number and diameter, in.	2-3
Thermic syphons, number	2
Tubes, number and diameter, in	190-2¼
Flues, number and diameter, in.	45-5½
Length over tube sheets, ft.-in.	19-0
Fuel	Bituminous
Grate area, sq. ft.	70.8

Heating surfaces, sq. ft.:

Firebox and comb. chamber	230
Arch tubes	14
Thermic syphons	71
Firebox, total	315
Tubes and flues	3,403
Evaporative, total	3,718
Superheating	1,315
Comb. evap. and superheat	5,033

Tender:

Type	Rectangular
Water capacity, gal.	16,500
Fuel capacity, tons	24
Trucks	Six-wheel
Journals, diameter and length, in.	6 x 11

General data, estimated:

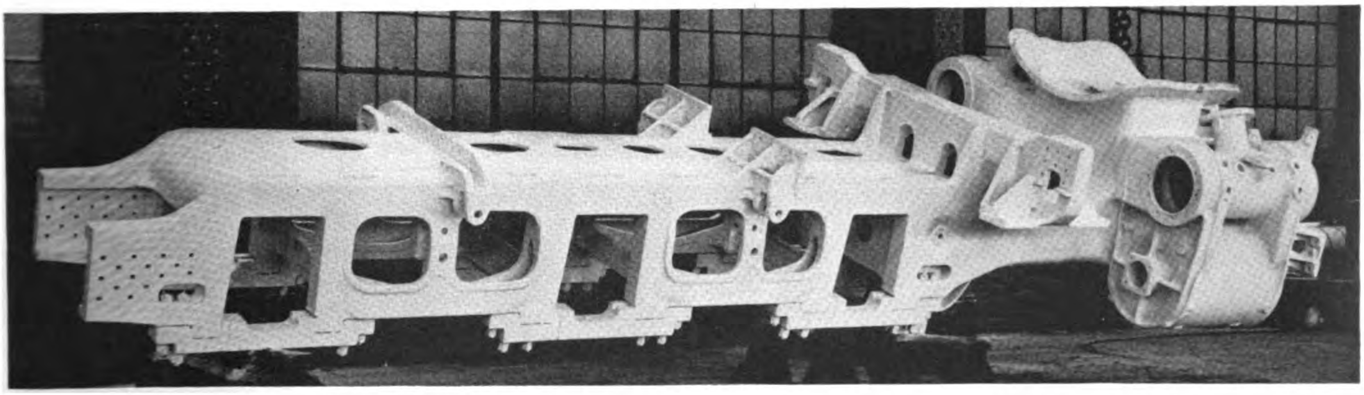
Rated tractive force, engine, 85 per cent, lb.	46,100
Rated tractive force, booster, lb.	12,075
Total rated tractive force. lb.	58,175

Weight proportions:

Weight on drivers ÷ weight engine, per cent	61.86
Weight on drivers ÷ tractive force	4.45
Weight of engine ÷ evap. heat. surface	89.26
Weight of engine ÷ comb. heat. surface	65.94

Boiler proportions:

Firebox heat. surface per cent comb. heat. surface	6.26
Tube-flue heat. surface, per cent comb. heat. surface	67.62
Superheat surface, per cent comb. heat. surface	26.22
Firebox heat. surface ÷ grate area	4.45
Tube-flue heat. surface ÷ grate area	48.06
Superheat surface ÷ grate area	18.57
Comb. heat. surface ÷ grate area	71.09
Evaporative heat. surface ÷ grate area	52.51
Tractive force ÷ grate area	651.13
Tractive force ÷ evap. heat. surface	12.4
Tractive force ÷ comb. heat. surface	9.18
Tractive force × diameter drivers ÷ comb. heat. surface	725.22



The Commonwealth bed casting has the cylinders, guide-yoke crossties and air-pump brackets cast integral

More Comfort in

Coach-Train Cars

Bulkhead seats eliminated and space per passenger increased in Budd-built equipment delivered during the winter for Florida coach-train service

DURING the past winter new passenger-train cars delivered to the Atlantic Coast Line and the Seaboard Air Line by the Edward G. Budd Manufacturing Company increased the capacity of the de luxe coach trains on each of these railroads to three trains of 14 cars each. In the general arrangement of combination cars, dining cars, and club lounges the new equipment followed the same general arrangement as was employed in the earlier orders of cars for these services. One exception is that the cars with observation sections were built with rectangular ends and vestibule connections instead of curved streamline ends. This permits the use of these cars in the middle of a train as well as at the end of a train.

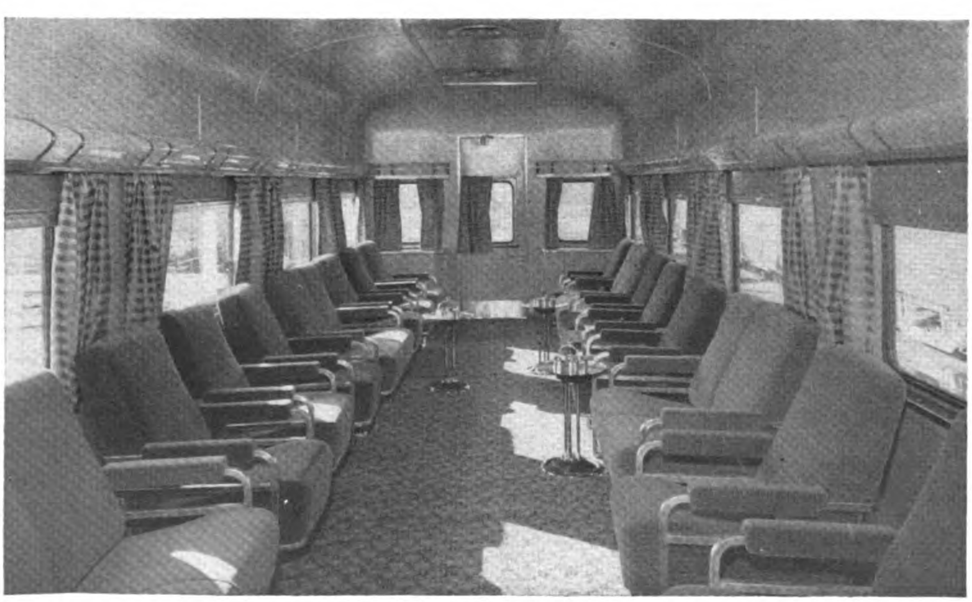
The new coaches in both of these orders, however, include refinements in the floor plan and additional toilet facilities, as compared with the earlier cars developed for de luxe overnight coach service by this builder. The earlier coaches were laid out for a seating capacity of 60 persons in the main passenger compartment with a men's room at one end of the car and a women's room at the other. The end seats of these cars were either fixed against the bulkheads and non-reversible, or were directly opposite the end of the corridors alongside the lounge rooms. The water cooler was placed against one of the bulkheads at the end of the aisle, where it was immediately alongside the seat at the bulkhead. In this way conditions were unfavorable for the comfort and privacy of passengers seated at the ends of the car.

In the new cars the floor plan has been arranged so that by the reduction of four persons in the seating capacity all seats are reversible and a uniform degree of privacy is afforded by each seat in the car. This has been accomplished by placing partitions between the end seats and the corridors alongside the rest rooms at the ends of the car. The water cooler has been moved from its former location to the corner of the corridor adjacent to the new partition.

In the earlier cars a single toilet opened from the rest room at each end of the car. In the new floor plan are included two toilets at each end of the car. These are placed alongside each other and occupy a space 2 ft. 4½ in. deep alongside the end of the rest rooms. The use of sliding doors made this arrangement practicable.

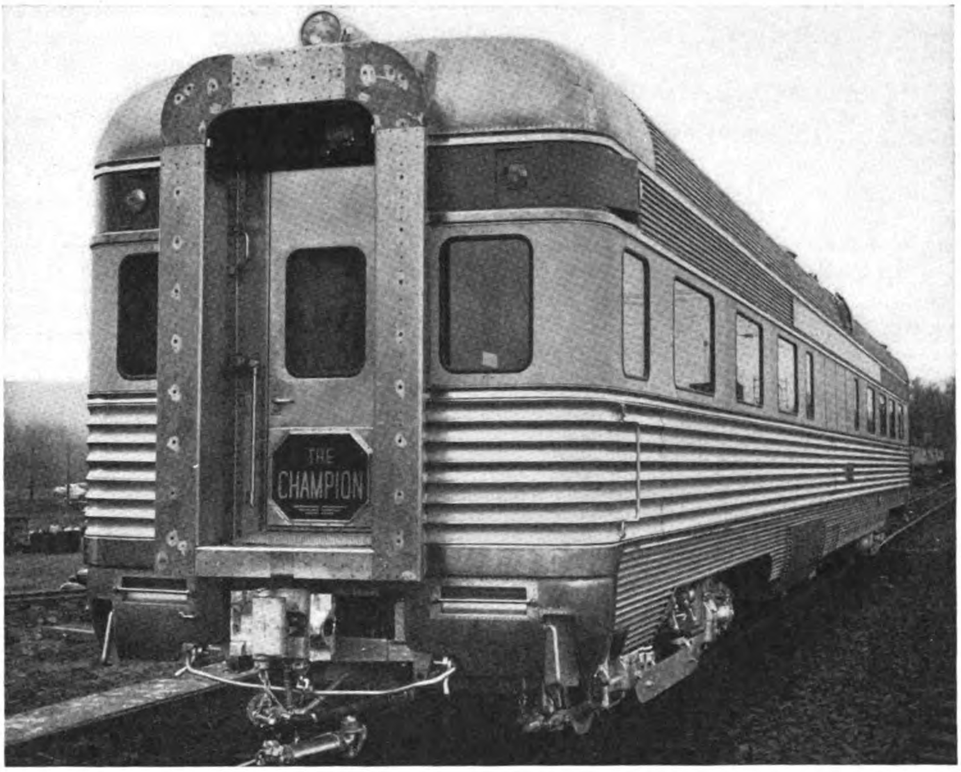
These cars, of which eight are in service on the Atlantic Coast Line and seven on the Seaboard Air Line, are of characteristic Budd construction. The center sills, side frames, floor sections, and roofs are of stainless steel, fabricated by the Shotweld process. Each car has a single vestibule entrance, and all are air conditioned.

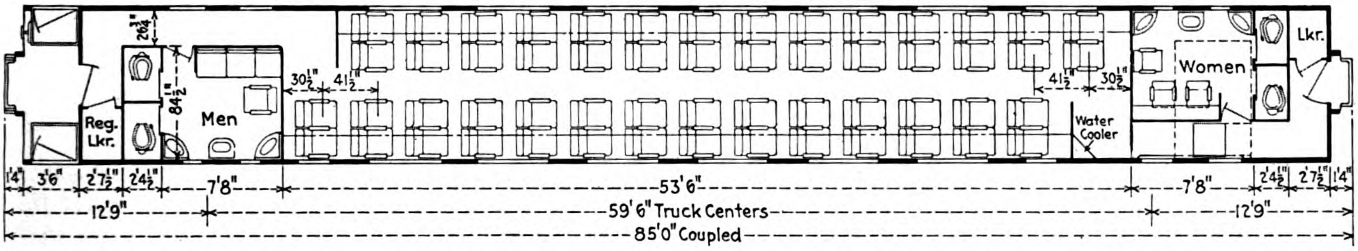
The six cars with square-end observation sections include three tavern-observation cars for the Atlantic Coast Line and three observation-chair cars for the Seaboard Air Line. The tavern-observation are similar in arrangement to those built previously for this service. However, besides the modification in rear-end contour, the floor plan of the observation-chair cars has been changed to include a buffet and a stewardess room. The buffet occupies a 5-ft. 8-in. section directly ahead of the observation room while the stewardess room is located in a 5-ft. 5½-in. compartment between the buffet and the chair section. These additional facilities, together with the elimination of bulk-head seats, has reduced the capacity of the chair section from 48 to 30 persons as compared to the cars of this type on the earlier orders. The seating capacity of the square-end observation section is 23, the same as the capacity of the curved-end observation sections. The general structural features of these cars are similar to those employed in the coaches.



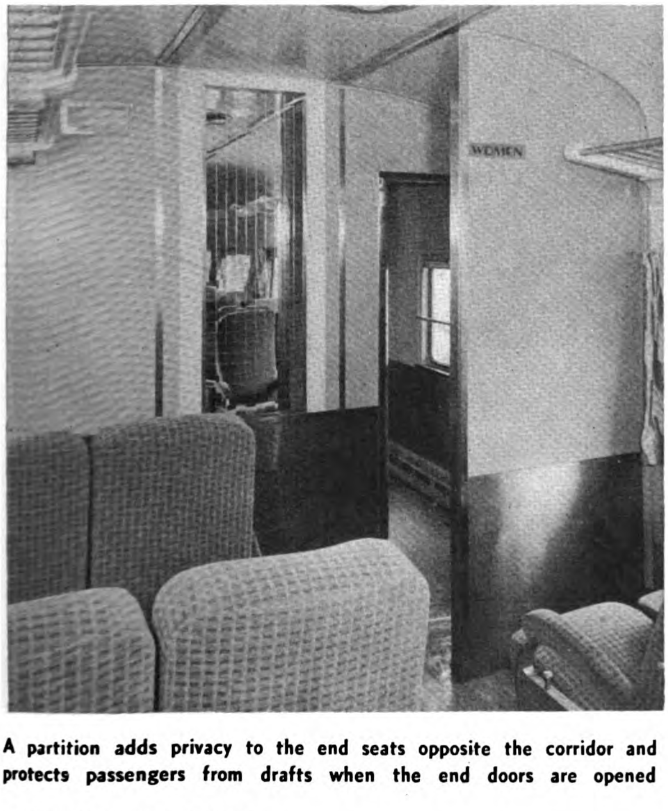
Interior of the square-end observation section

The square-end observation car for the Atlantic Coast Line's Champion. Similar cars were built for the Seaboard Air Line's Silver Meteor

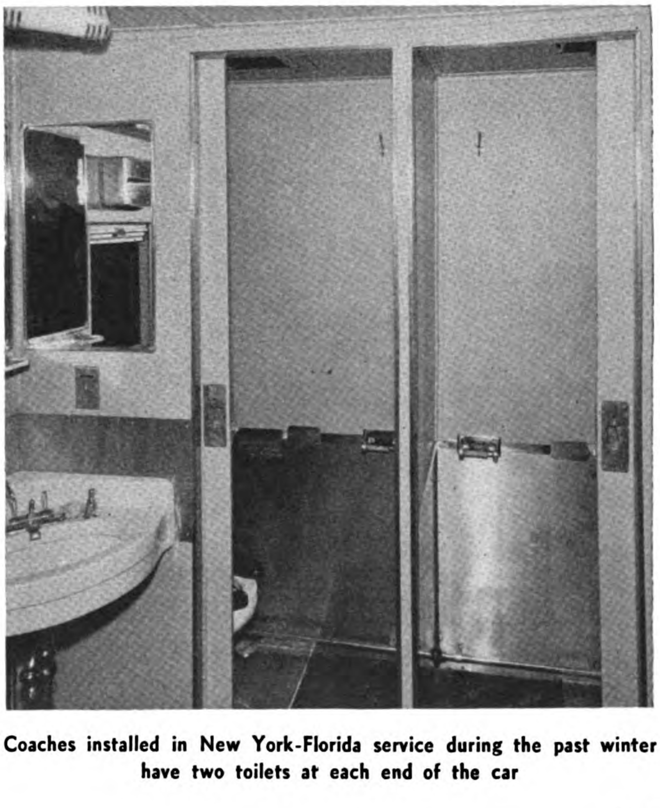




The floor plan of new Budd-built coaches which have been in service in the New York-Florida de luxe coach trains during the past season



A partition adds privacy to the end seats opposite the corridor and protects passengers from drafts when the end doors are opened



Coaches installed in New York-Florida service during the past winter have two toilets at each end of the car

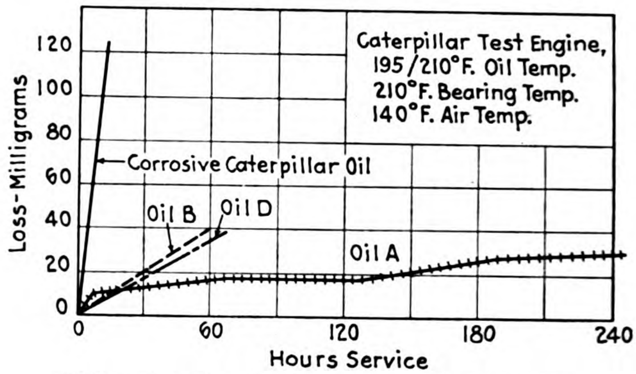
Heavy-Duty Detergent Lubricant

The Standard Oil Company of New Jersey has announced a new type of engine lubricant, Essolube HD, developed to overcome piston varnishing, ring sticking and other major lubrication troubles of heavy-duty, high-speed Diesel and gasoline engines. It has a viscosity index of approximately 100, nearly twice that previously available in special detergent oils, meeting the full range of known heavy-duty engine requirements. This new lubricant has, in addition to its resistance to oxidation and high temperature, the ability to wash out sludge deposits, protect bearings from corrosion and to prevent substantial deposits of varnish on pistons, valve stems, rings and other engine parts. It also has a valuable rust preventive action.

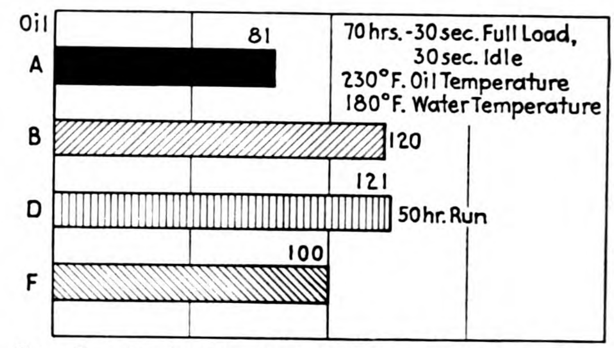
Detergent type oils in themselves are not new. Heretofore, however, oils with sufficiently high detergent or washing properties to eliminate ring sticking, varnishing and sludge deposits in the full range of present heavy-duty engines have had, for chemical reasons, to utilize base stocks of relatively low viscosity index. While such oils markedly improved engine cleanliness, many engines have required, in addition, high resistance of the base oil itself to oxidation and bearing corrosion. A major problem for petroleum chemists, has been to develop an oil which, while possessing these detergent properties, had the high stability usually characterized by lubricants of high viscosity index.

Viscosity index, while primarily a measure of an oil's ability to resist change in viscosity with changes in temperature, is also a useful measure of the stability and protection furnished in service. Laboratory evidence shows that the stability of an oil against oxidation and heat increases, in general, with the viscosity index of the oil.

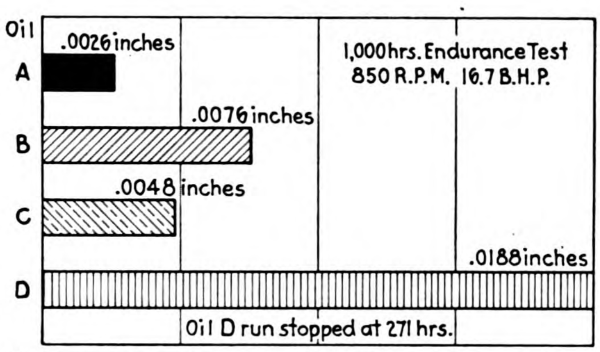
Essolube HD has been tested in the laboratory and



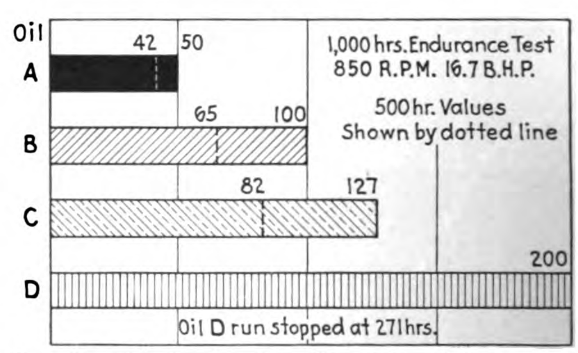
Weight loss of copper-lead bearings—Corrosion tests



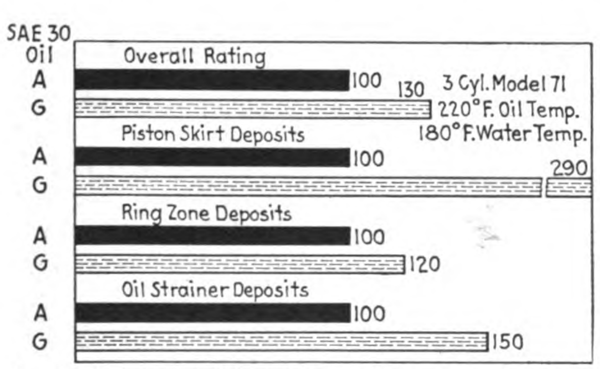
Over-all engine deposits—General Motors three-cylinder engine



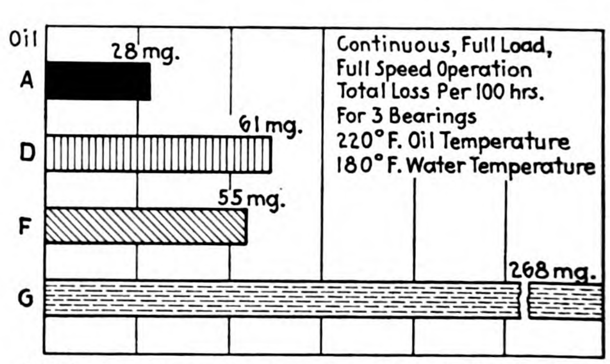
Maximum cylinder liner wear—Caterpillar single-cylinder engine



Over-all engine deposits—Caterpillar single-cylinder engine



Five-hundred-hour, full-load, full-speed test—General Motors Diesel



Weight loss of copper-lead bearings—General Motors three-cylinder engine

DESCRIPTION OF OILS TESTED

A—Essolube HD, a high-viscosity index oil
B—Low-viscosity index compounded Diesel oil
C—Low-viscosity index compounded Diesel oil, limited for use to engines with babbitt bearings
D—Straight mineral oil of medium viscosity index used in moderate duty Diesel service
E—Straight mineral high-viscosity index oil used as the base in oil "A"
F—Straight mineral oil of high viscosity index
G—Compounded oil in low-viscosity index base stock using addition agents radically different from oil "A"

on the road in actual service operations, the summary of some of the laboratory test results being shown in the charts. It has passed the General Motors Diesel engine test, which calls for a 500-hr. run in a General Motors high-speed Diesel engine under full load and at full speed without oil change. It has also been formally approved by the Caterpillar Tractor Company for use in its Diesel engines, passing the 1,000-hr. endurance runs in a Caterpillar engine under both laboratory and field conditions. Essolube HD is the first high viscosity index lubricant to obtain Caterpillar approval and the first high viscosity lubricant to have passed both the Caterpillar and General Motors Diesel engine test requirements.

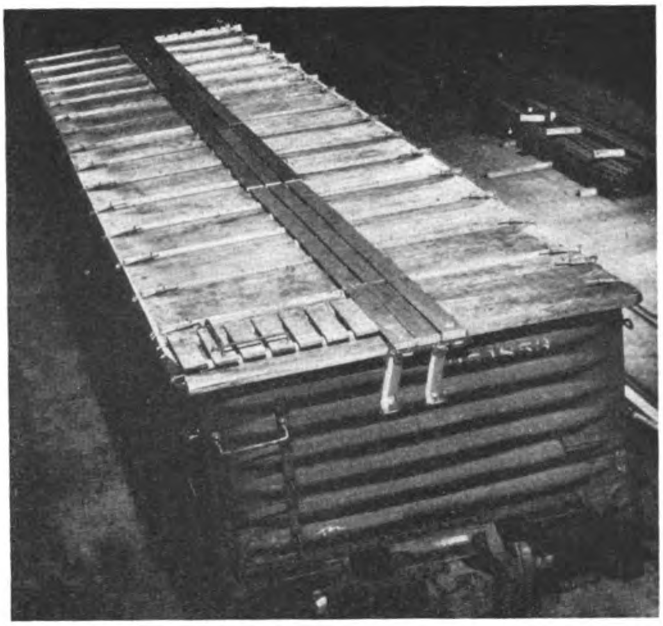
Sectional Top Protects Gondola-Car Lading

In an effort to make the use of gondola cars more universal, permitting their use for a wider range of products, a new section top has been devised for gondola cars which protects the contents of the car from weather and tampering. The sectional top, light in weight and easily installed and disassembled, was developed by J. M. Hilbish and J. H. McCahan, Pittsburgh, Pa.

The top is fabricated from No. 20 gage sheet steel and reinforced with 3/16-in. by 1-in. flats and 1-in. by 1-in. by 3/16-in. angles. One section weighs about 70 lb. and is either 24 or 34 in. wide with length adjusters to fit varying car widths. The entire top for a 46-ft. car weighs about 1,200 lb. A top is usually formed of 16 sections that interlock with each other by means of a standing seam, interlined with sponge rubber that forms a waterproof seal. Waterproof paper is laid between the sections and the car sides to prevent seepage.

The complete top can be installed by two men in less than two hours, while the removal of the top is a matter of only a few minutes. Each section is fitted with a board cat-walk, forming a car-length walk when all covers are in place, thus affording a means for traversing the car top in safety. Each section will support the weight of three men on the cat-walk. Heavy coil-spring fasteners, permanently attached to each section, hook over the bulb angles at the side of the car and hold the section rigidly in place. Special lever tools carry out the fastening process easily and quickly, providing a fastening which cannot be tampered with in transit.

The system, patented, has been approved by the Interstate Commerce Commission and the Bureau of Safety.



The sectional top applied to a gondola car

* * *

This 4,000 hp. Diesel-electric locomotive, designed and built by the American Locomotive and General Electric Companies, left Schenectady, N. Y., early in May for delivery to the Atchison, Topeka & Santa Fe. It is destined for regular service on the Super Chief

Suggestions for Mechanical Associations

M. B. M. A. Correction

The circular letter sent out on April 7, 1941 by Albert F. Stiglmeier, secretary-treasurer of the Master Boiler Makers' Association, to the association members, listed John A. Doarnberger as chairman of the committee on Resolutions and William N. Moore as chairman of the committee on Memorials. This listing should have been just the reverse as Mr. Moore was selected to serve as chairman of the Resolutions Committee and Mr. Doarnberger as chairman of the Memorials Committee.

Coal Equivalents Widely Vary

Under existing instructions, the monthly consumption of the various kinds of fuel and power are reported to the Interstate Commerce Commission by each railroad "reduced to their equivalent in net tons of coal, using such ratios of equivalence in heating values as the experience of the respondent indicates are applicable to local conditions." These quantities, stated as net tons of coal, are combined in the statistical statements of performance for the various districts and regions and for the Class I railways as a whole, and inevitably there is some tendency toward the drawing of comparisons between the performances of individual roads, even between those that use different kinds of fuel and power. The wide fluctuation in "coal equivalents" used by the various railroads is notorious and leads, in some instances, to gross misinterpretations of fuel performance figures. The Railway Fuel and Traveling Engineers' Association has attempted to clarify this situation in the past and again this year its Committee on Fuel Records and Statistics will submit at the annual Fall meeting proposals for uniform formulae which might be adopted by all the railroads for determining the coal equivalent of each kind of fuel and power. While it is not anticipated that agreement can be obtained to the use or rigid formulae for general application, it is hoped to develop formulae which will take into account any reasonable local variations and at the same time narrow materially the present extreme variation in values of "coal equivalents."

The C. D. O. A. Is Complimented

According to the last figures available, Class I line-haul railways are spending practically $233,000,000 a year for passenger and freight car repairs, and in order for this outlay of money to bring the greatest possible returns through improved car equipment conditions, it is obvious that car foremen and supervisors of all ranks must be alert to discover and adopt improved practices in the application of car repair materials and in the handling of car maintenance forces. Since some of the most aggressive and progressive car supervisors in the country are members of the Car Department Officers' Association, it is obvious that the annual meetings of this Association present an excellent opportunity for all those in attendance to pick up new ideas regarding car maintenance, as well as design and use. The increasing recognition of the potential usefulness of the Car Department Officers' Association is shown by letters recently received from 40 mechanical department heads who expressed thanks for individual copies of the 1940 Proceedings which were sent to them and complimented the association by offering to permit local car supervisors to serve on various committees where they can do the most effective work. Typical is the comment of one chief mechanical officer who says "While I have not had an opportunity to go through the Proceedings to any great extent, I know from past performance of this organization that there is a lot of good data contained therein. I approve of the selection of the officers on the . . . and will co-operate with you to the fullest extent in making your organization a success." The national scope of the Association's activities is indicated by the fact that these letters came to the secretary's headquarters at Chicago from mechanical officers at such distant and divergent points as Montreal, Can., Derby, Me., Savannah, Ga., Dallas, Tex., Los Angeles, Cal., Sacramento, Cal., St. Paul and Minneapolis, Minn.

Present Papers in Full

I have noted with much interest the page entitled "Suggestions for Mechanical Associations," in the late issues of the *Railway Mechanical Engineer*. Many of the articles published have mentioned the forwarding of advance copies of the committee reports to the membership, and the presentation of only abstracts of the reports at the meeting.

The writer is quite confident that best results are obtained by the reading of papers in full. This has been demonstrated at the meetings of the Master Boiler Makers' Association, where it has been the procedure for the committee members, when their paper is being read and discussed, to be alert and participate in the discussion of their committee report. If the papers and discussions published in the 1940 proceedings of the Master Boiler Makers' Association are scrutinized, one will note that it is not necessary to forward advance copies of the committee papers to the membership, but rather, it is essential that those in attendance be kept interested during the reading of the paper and its discussion.

Further, to bring about interesting and beneficial meetings, no selfish attitude can be shown towards individuals or other associations. An endeavor must be made for closer cooperation between associations in joining in the presentation and discussion of papers as has been demonstrated by the Water Service Committee of the American Railway Engineering Association ,the International Acetylene Association, university personnel, locomotive builders, other industries and the M. B. M. A.

Also, the proceedings that contain the committee and special papers and their discussions should be made available without charge to railroad officers, mechanical associations, university and public libraries in the United States, Canada and foreign countries as is the practice of the Master Boiler Makers' Association.

With such cooperation, the minor railway mechanical associations will continue to function and be of benefit to the railroads and the association membership.

Albert F. Stiglmeier, *Sec.-treas.,*
Master Boiler Makers' Association

The title of a mailing piece prepared recently by Locomotive Maintenance Officers' Association—"Have You Got Troubles," will probably strike a sympathetic chord with most of the railroad mechanical department men who get one. The circular tells about the association's background, who runs it and what are its objectives

Centralized Repairs for

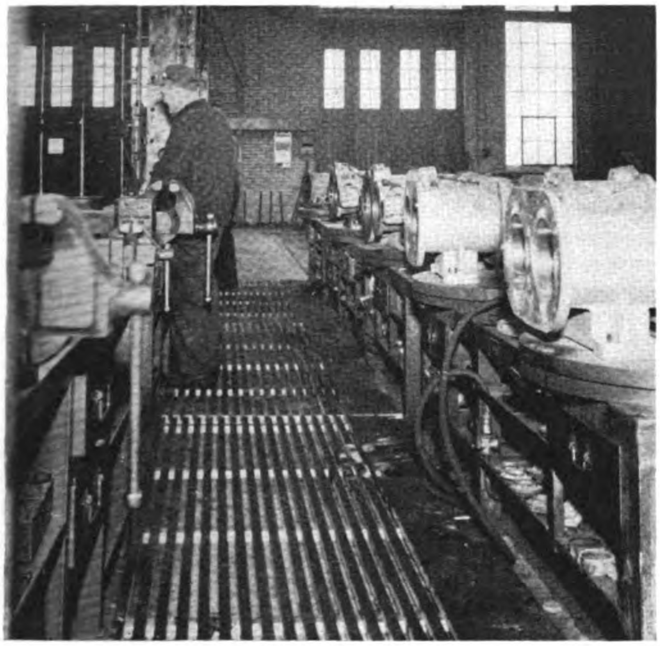
Air Pumps and Reverse Gears

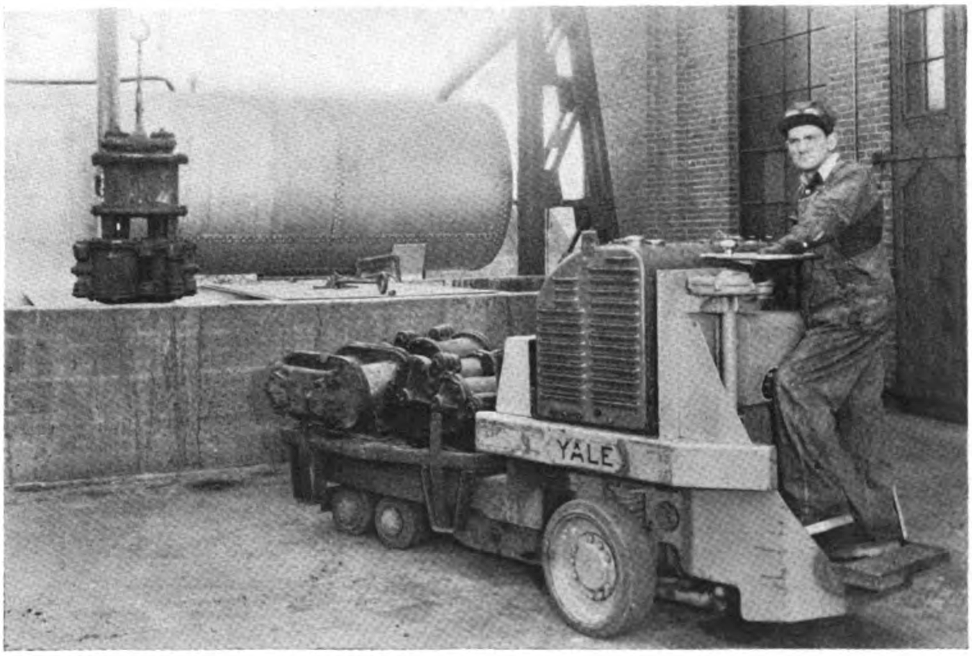
By G. H. Raner*

A shop department especially arranged and equipped for making heavy repairs to locomotive air compressors and power reverse gears is now being operated with unusually satisfactory results at the Paducah, Ky., locomotive shops of the Illinois Central. All air compressors and power reverse gears from locomotives for the entire system are repaired at this central shop, the general storehouse at Paducah affording a convenient, efficient and prompt means of handling the equipment to and from the various shops on the system.

Compressors are sent in for repairs principally mounted on skids and are handled from the storehouse car unloading ramps to the repair shop by means of a lift truck. Such a truck is shown delivering compressors to the lye vat. This vat consists of four compartments each 10 ft. long by 6 ft. wide by 6 ft. deep, arranged for the particular purpose of cleaning compressors. The capacity in three of the compartments is six No. 5 New York Duplex compressors and three Westinghouse 9½-in. compressors; the fourth compartment of the vat is used for rinsing the compressors with hot water after they have been cleaned. The compressors are raised and placed in the vat with an overhead craneway and an electric hoist. They are not just placed in the lye vat as is ordinarily done in the case of other materials, but are held upright on metal racks attached to the sides of the vat, the steam end of each compressor protruding just above the cleaning solution. No bolting or clamping is necessary.

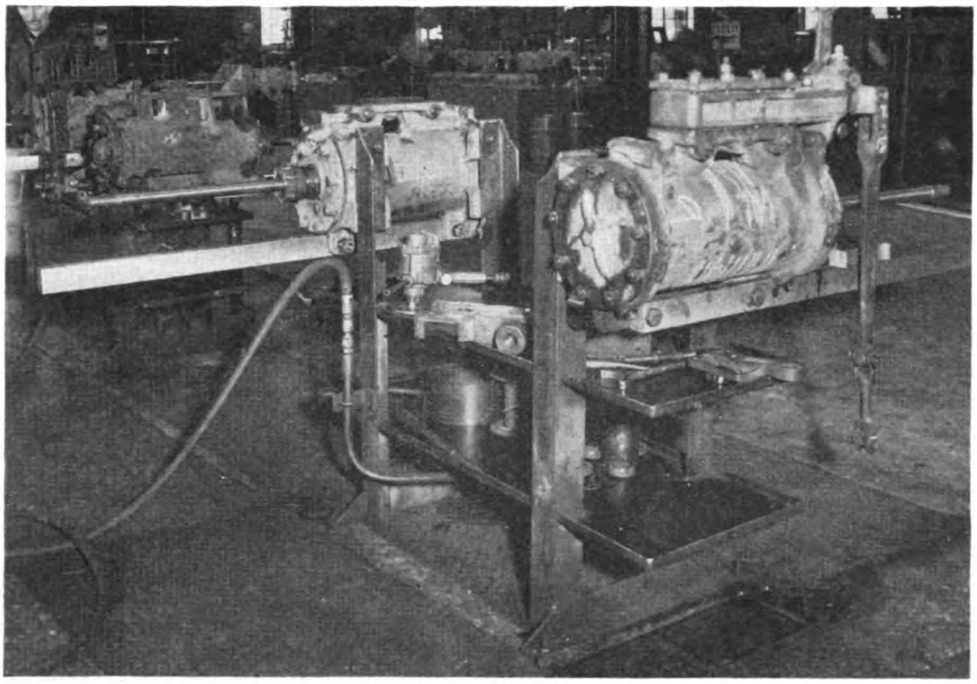
Steam connections are then made to both intake and exhaust, the exhaust pipe being arranged so that the exhaust may be carried up overhead. The compressors are then operated by steam while submerged, pumping the hot vat solution through the air end of the pump, which cleans the inside at the same time the outside is undergoing cleaning. A multi-jet discharge pipe is connected to the air end of the pump and formed to fit partly around the center casting, through which the solution is discharged to clean that portion of the pump thoroughly and in the least time. After the compressors remain a sufficient length of time for proper cleaning, they are removed and placed in the rinse compartment of the vat, coupled to a steam line and rinsed with water.





Above: Compressor assembly bench equipped with five revolving tables to facilitate repair work—Right: Moving air compressors on a skid and lift truck to the lye vat

* Assistant shop engineer, Illinois Central.

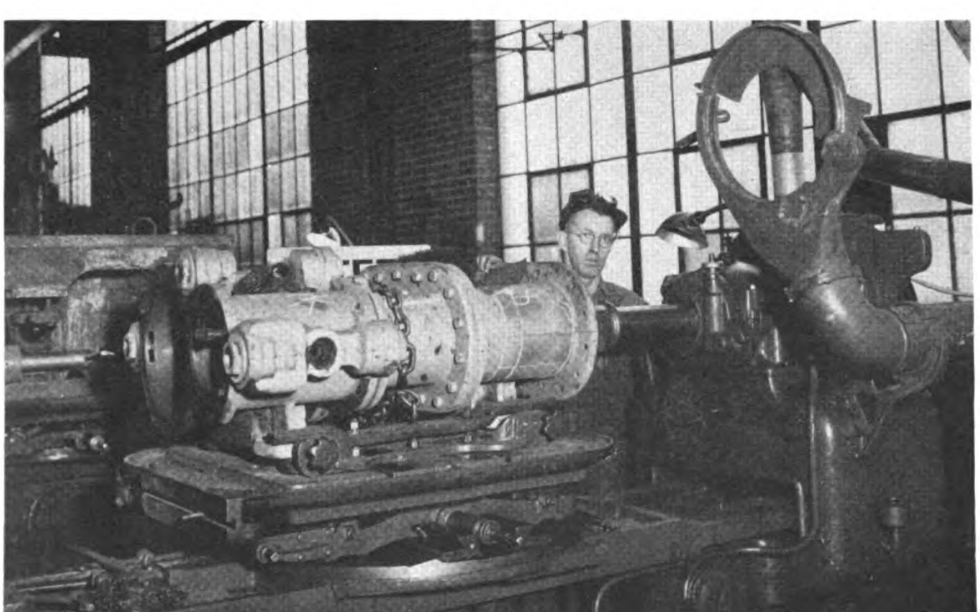


Convenient repair rack on which power reverse gears are overhauled

After this cleaning process, the compressors are placed back on skids and moved into the air room by means of a lift truck for the second operation, namely, that of stripping, inspecting and necessary calipering of the cylinder diameters. When cylinders are worn to the point of requiring rebushing, they are bored out on a 54-in. vertical turret lathe; the bushings are applied by means of an hydraulic press at approximately six tons pressure for 8-in. bushings and 10 tons for 12-in. bushings. In either case, whether or not new bushings are necessary, the cylinders are all smoothly ground on one of the Micro internal grinders, such as is shown in one of the illustrations. Compressors are then moved to the assembly bench where new pistons and rings are fitted or the old pistons turned on a lathe, located adjacent to the Micro grinder, so that the repair work may be carried on in a progressive way.

One of the many interesting features of this shop is the assembly bench arrangement, which consists of a long table or work bench, on which is mounted five revolving circular tables, made of cast iron in two parts, each 38 in. in diameter and 1¾ in. thick. Between the two there is a ball race 30 in. in diameter which contains one hundred ⅞-in. balls. In the center is a 2-in. pin which holds the top and bottom plates central. The bottom plate is fastened to the table with four ¾-in. bolts, the heads of which fit into counterbored holes. The top plate has suitable holes tapped out for cap screws, spaced so as to hold either of the two types of compressors while being assembled. Just underneath the bottom plate at the outer edge and within easy reach of the repairman, there is a spring-operated plunger that fits in holes suitably located in bottom of the top plate so that the operator may reverse the compressor by revolving the table at any angle to work on either end. This, of course, eliminates the necessity of the operator walking around the compressor or table.

Under each compressor, shelves are available to hold



Micro internal grinder on which compressor cylinders are accurately ground

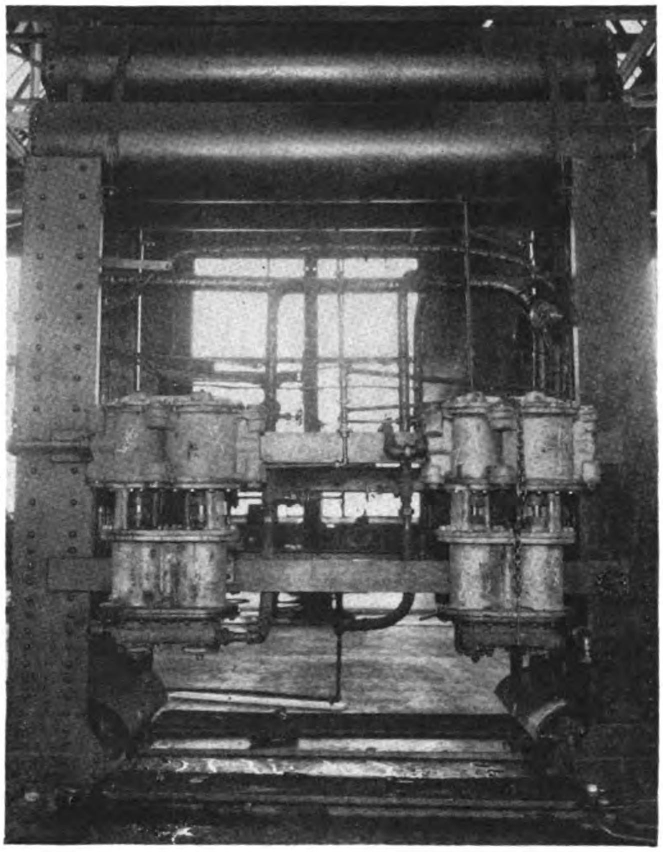
the tools the repairmen need, a convenient arrangement which saves many steps. Directly back, there is a vice for each repairman to use when necessary and also bench space and drawer space for any additional tools or equipment that may be used in assembling the compressors. With such an arrangement, lost motion and extra moves are eliminated. This set-up makes it possible for a mechanic to assemble an entire pump without moving much more than within a radius of two feet.

After the compressors are assembled, they are moved to a permanent test rack where they are thoroughly tested and operated for several hours under pressure, for testing of valves and packing rings and general operation of the compressors.

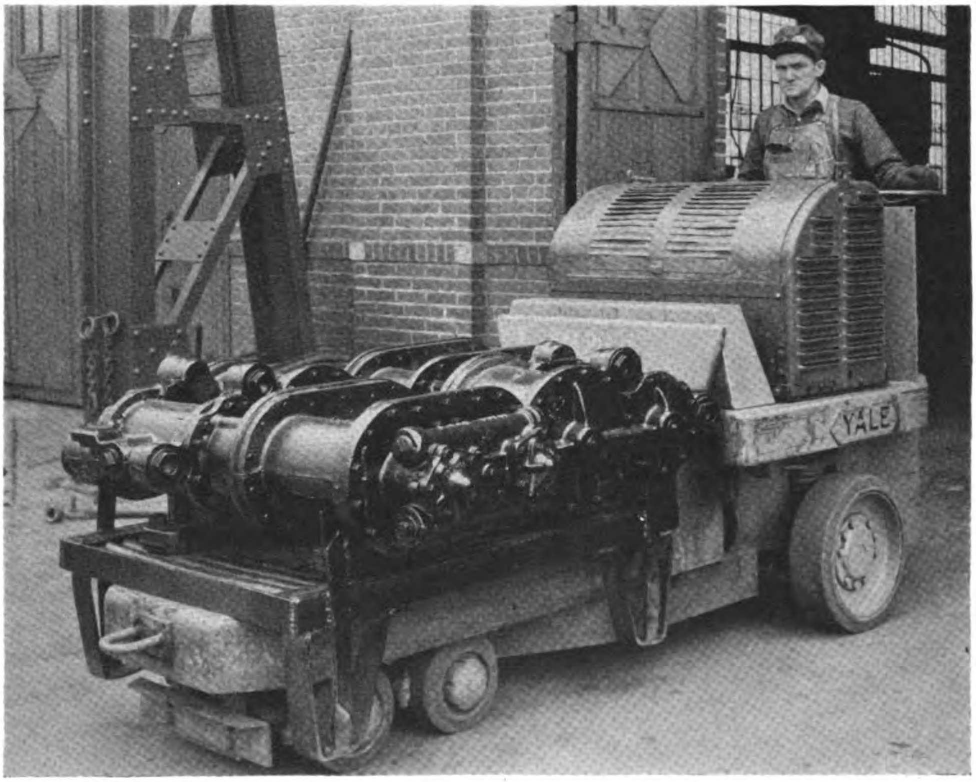
Another photograph shows the test rack on which two compressors are undergoing test. Three air reservoirs may be seen located just above the pumps and piping which is merely an air storage. Compressors are bolted to properly spaced and suitable brackets on the rack. They are handled to and from the test rack by an overhead traveling crane on which is mounted a one-ton capacity electric hoist.

After the compressors are tested, ordinary pipe plugs are screwed into the intake and outlet ends, the heads are blown out with air to eliminate moisture and just enough oil run in to prevent rusting until the compressors are returned to service again. Compressors are sprayed on the outside with a cheap grade of light paint to eliminate rust; they are loaded on flat top skids and moved directly to the storehouse for distribution. No compressors are shipped with connections or studs in place as they are all removed to eliminate damage in handling. It will be observed that the lugs of the finished compressors shown on the truck are protected against breakage when handling by means of ⅝-in. by 4-in. steel plates extending between each horizontal pair of lugs and firmly bolted to them.

Only locomotive air pump compressors that are worn to the point of requiring general overhauling are forwarded to Paducah; in other words, only those compressors that have been in service on a locomotive from one Class 2 or 3 shopping to another, unless, of course, because of accident or some unusual incident. In order to control this feature, a bronze badge plate is attached to the center piece of each compressor after it is re-



Test rack used in checking air compressors after being repaired



Moving repaired compressors to the storeroom—The lugs are protected with metal strips

paired on which the following information appears: Serial number; repaired at Paducah; date applied; place; engine number; date removed and place.

The serial number and date repaired are steel stamped on the badge plate at the compressor repair shop. The date applied, place and engine number are steel stamped by the shop where the compressor is applied to the locomotive; also date removed and place, this being the final date removed. A record of mileage on each compressor is maintained in the repair shop as the compressors are returned. Old dates are filed off and new applied at class repairs.

Power Reverse Gear Repairs

Power reverse gears of all types in service on the Illinois Central are given general repairs in this shop, also at the time of general shopping of the locomotive. The procedure is that they are first cleaned by submerging in a lye vat, the exteriors being cleaned only and rinsed off. They are then moved into the shop and placed on racks, one of which is clearly illustrated. Each rack accommodates two power reverse gears and there are five double racks in the department. These racks are rigidly constructed and of a sufficient height so that the gears can be readily worked on by repairmen. It will be noted that the racks have two shelves for necessary tools and packing. Work benches and vices are conveniently available, with suitably located air connections at each rack for necessary testing.

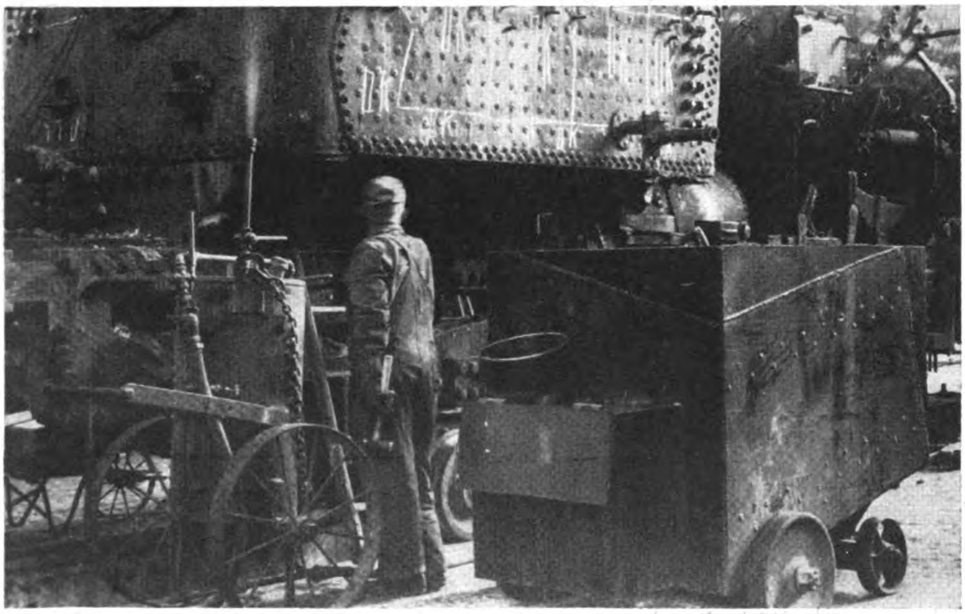
After being placed on the racks, a thorough check is made by means of calipers and gages and, if a cylinder is found to be scored or otherwise marred requiring redressing, it is then bored and ground on a Micro grinder. A 5⁄16-in. limit of oversize is allowed on both the 9-in. and 7-in. power reverse gear cylinders. Only about one out of each five cylinders required boring and grinding; none are rebushed. Adjacent to the rack is a small drill press and shaper and such other small tools as are necessary for efficient handling of repairs to power reverse gears. There is also a lathe conveniently located to true up pistons and rods.

While the maintenance work of both air pumps and power reverse gears is located in the same repair room, each is independent of the other. Machines and equipment are provided and so arranged so that one will not interfere with the other. When repairs are completed to power reverse gears, they are thoroughly tested, properly tagged and a rust preventive applied. In addition to the two kinds of equipment repaired in this shop, as already described, all locomotive gages are repaired, including quadruplex air gages, steam gages, back-pressure gages and air gages. Such parts as pneumatic bell ringers and fire-door openers are also repaired here.

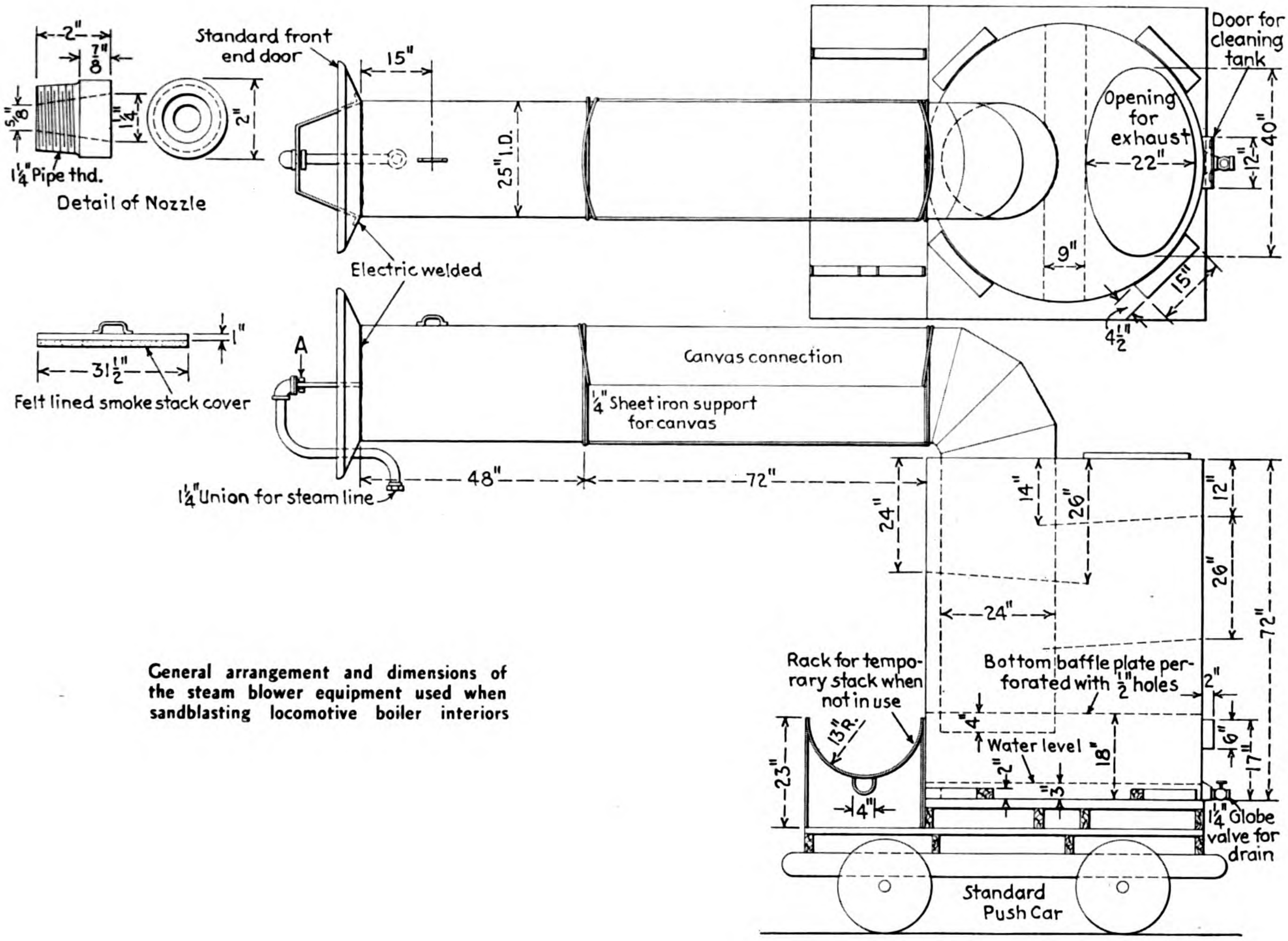
This repair shop now maintains the equipment formerly repaired in 14 different shops. An output of locomotive air compressors, power reverse gears and other miscellaneous equipment mentioned is set up in advance and calculated on the number of locomotives which are expected to be given general repairs within a 12-month period. In this way of handling, the monthly output for that period remains constant and results in more efficient and economical procedure.

Sandblasting Boiler Interiors

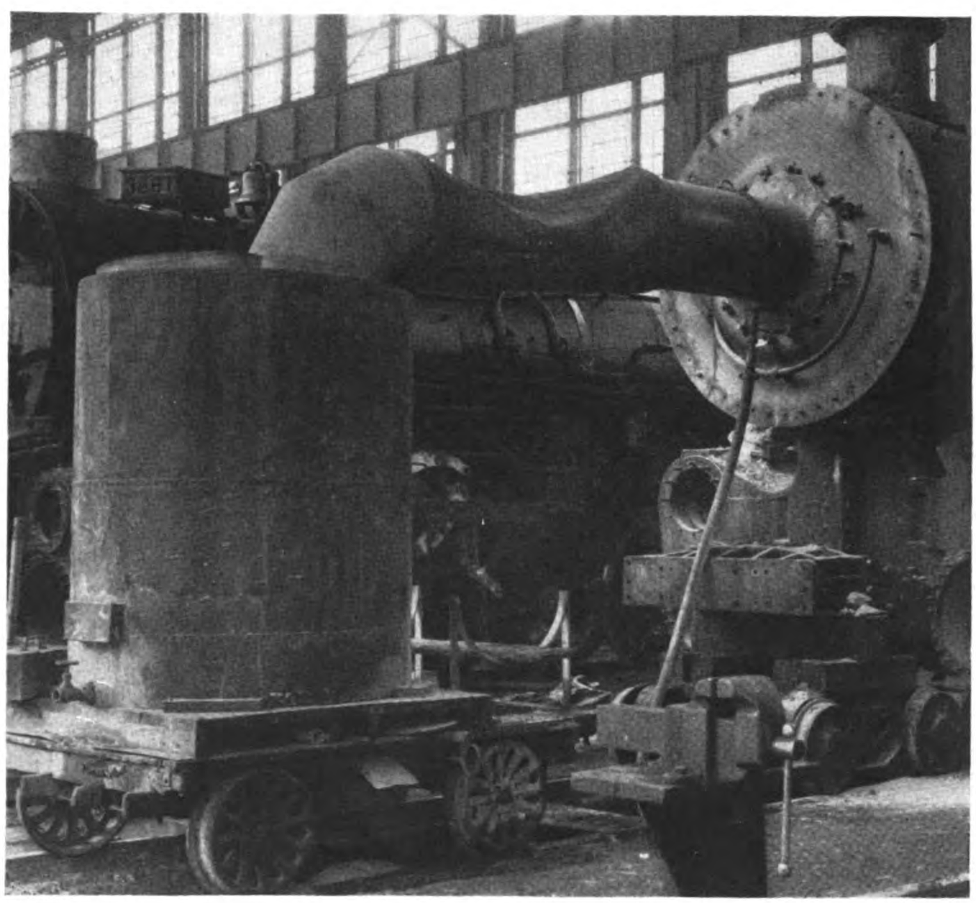
Whenever, for any reason, it may be convenient or desirable to sandblast the interiors of locomotive boilers without removing the locomotives from the erecting shop, the equipment shown in the illustrations may be used to do a thorough job without objectionable sand and dust particles filling the air and being deposited on shop machinery, locomotive parts, and tools. This equipment, developed at the Atchison, Topeka & Santa Fe shops, San Bernardino, Cal., makes it feasible to use the sandblast method of cleaning boiler interiors instead of removing scale with an air gun, a laborious time-consuming operation and one which is prohibited in the case of nickel-steel boilers on the Santa Fe. The sanding method is particularly advantageous in cleaning



Truck-mounted sandblast tank and equipment including auxiliary sand supply wagon which carries enough sand for one boiler interior



General arrangement and dimensions of the steam blower equipment used when sandblasting locomotive boiler interiors



Steam-blower-type exhaust equipment used at the San Bernardino shops of the Santa Fe when sandblasting boiler interiors in the erecting shop

boiler stays and, in fact, it leaves the entire boiler interior in excellent condition for the inspector to make a thorough, accurate check whenever tubes and flues are removed for class repairs.

This method of sandblasting boiler interiors depends upon an efficient exhaust system which includes, primarily, putting a felt-lined cover over the smoke stack and locating a steam jet at the center line of a 25-in. exhaust pipe extending from the front end door through a canvas sleeve connection to a sheet-metal tank which is thoroughly baffled so as to let the exhaust air escape from the top, but retain all of the dust particles in the tank. With the steam jet in operation, therefore, a strong draft is created in the boiler, drawing air from the firebox out through the front-end door, and sanding operations using conventional equipment may be carried on in the barrel of the boiler without hazard to the sandblast operator or to shop men working around the locomotive.

Details of the exhaust equipment are illustrated. The part attached to the locomotive consists of a false boiler front door of standard size, cut out at the center to receive one end of a 25-in. by 48-in. cylinder made of ¼-in. tank steel and securely welded to an air-tight joint with the door. A 1¼-in. steel pipe section carries the steam line through the front end door where it is bent and connected to an ell and nozzle directed along the center line of the 24-in. pipe and supported 12 in. back of the door by means of a bracket iron. This nozzle is tapered from ⅝ in. to 1¼ in. diameter in 2 in. of length in the direction of steam flow and consequently fills the exhaust cylinder and creates an efficient draft with an initial pressure of about 80 lb. In addition the steam has the effect of partially killing the dust.

The sand receiving end of the exhaust equipment consists of a sheet-metal tank, 4½ ft. in diameter by 6 ft. high, made of galvanized iron, mounted on a four-wheel push car and having a 24-in. elbow at the top connected to a straight vertical section of pipe which extends down to within 14 in. of the bottom of the tank. The tank is thoroughly baffled with a total of four baffle plates, the lower one, perforated with ½-in. holes, being located 18 in. above the bottom of the tank which is covered with about 3 in. of water. A check of the measurements will show that the 24-in. vertical pipe extends 4 in. through the bottom baffle plate and discharges the air, condensed steam and dust directly onto the surface of the water. A large elliptical opening in the top of the tank allows easy escape of the exhaust air. A 6-in. by 12-in. hinged door for hand cleaning is located in the side of the tank 17 in. above the bottom and a 1¼-in. globe drain valve is installed as near the bottom as possible for flushing purposes.

Connection between the exhaust cylinder on the front-end door and the 24-in. galvanized ell is made by means of a canvas sleeve 6 ft. long with draw strings at either end to assure practically air-tight joints. Support for the bottom of the canvas sleeve is afforded by a sheet-metal strip curved to fit the radius of the cylinder and the ell and held firmly against them by light wire or cable connections. A rack on the front of the push car makes a convenient place to carry the exhaust cylinder and front end door when not in use.

Reference to the view showing the firebox end of the locomotive shows the sandblasting equipment used in cleaning the boiler interiors. This consists of the usual sand and air tank mounted on two large wheels for portability and equipped with the necessary fill-up cap, operating valves and 2-in. hose connections to the sanding nozzles which are used to give direction to the air and sand stream in the boiler. A good cutting sand is required and air pressure is supplied from the shop line at about 100 lb. per sq. in. The auxiliary sand-supply wagon, shown at the right in the illustration, carries enough sand for cleaning one entire locomotive interior.

The removal of scale from the inside of a locomotive boiler using this equipment is relatively simple. The sandblast operator, equipped with suitable clothing, gloves and a helmet which takes air from outside the boiler, begins at the bottom of the front course and gradually cleans scale and rust off the sides and top of the course, then backing up to the next course and repeating the operation until the entire boiler interior is cleaned. The average time required is about eight hours, dependent first upon whether the boiler has ever been scaled before and second, how long it has been empty prior to sandblasting. The operation of cleaning is relatively easy when the boiler has just been cooled down and the flues removed.

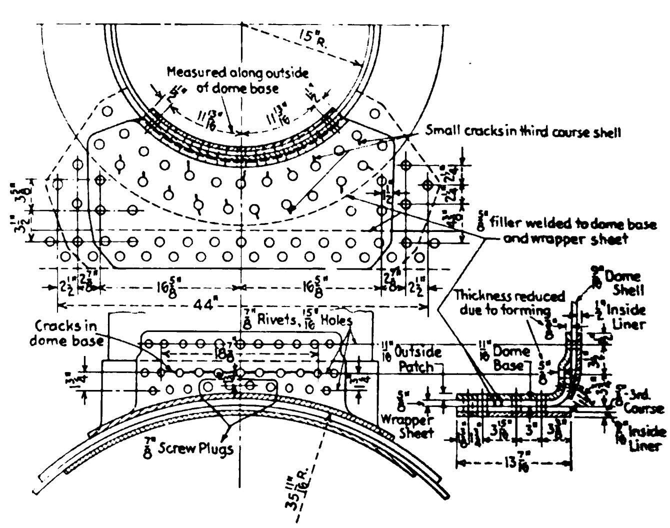
After sandblasting, the heavy sand and scale on the interior of the boiler are scooped out through the flue sheet and disposed of, the sand being lost since it cannot be separated from the scale. Damp, heavy dust in the truck-mounted sheet-metal tank is removed through the clean-out door and dumped, the residue being washed out through the drain valve.

Steam-Dome Reinforcement*

The boiler patch shown on the drawing proved to be quite a problem in fabrication. As may be seen, the defects to be reinforced were composed of several small cracks in the boiler shell at the rivet holes in the steam-dome base. There was also an 18⅞-in. crack through the rivet holes in the dome base at the shell connection.

The patch was first rolled to the outside radius of the dome base on the boiler. Then it was flanged to a 15 9/16-in. radius about an axis at a 90-deg. angle to the original roll. Finally, it was offset over the top of the dome base so as to fit the dome shell. The greatest problem involved was that of holding to a minimum the reduction in the thickness of the material during the flanging process. The top of the flange was reduced from 11/16 in. to ⅜ in., thus requiring an inside liner to restore the original strength at the 18⅞-in. cracks in the dome base.

* An entry in the prize competition on boiler patches announced in the March, 1939, issue. The names of the prize winners were published in the August, 1939, issue.



Boiler patch application at steam-dome base

Questions and Answers On Welding Practices

(The material in this department is for the assistance of those who are interested in, or wish help on problems relating to welding practices as applied to locomotive and car maintenance. The department is open to any person who cares to submit problems for solution. All communications should bear the name and address of the writer, whose identity will not be disclosed when request is made to that effect.)

Wear Plates And Broken Frames

Q.—In recent months we have had an epidemic of broken locomotive frames. The odd part of this is that the majority of these frames have broken where the spring hangers chafe the frame. These worn spots have been covered with a wearing plate electrically welded in place. Can you tell what is causing this?

A.—This condition seems to exist wherever wear plates are arc-welded to the frame. The bead of weld placed alongside the plate when welding the plate to the frame seems to cause a tiny fracture which in time causes a broken frame. Many roads have discontinued this practice and are filling these worn spots solid with either the electric or the acetylene process. Wear-resisting bronze is an excellent material to repair these worn spots with.

Eliminating Blow Holes in Brazing

Q.—We have considerable trouble brazing pistons. The deposited bronze is sometimes so full of blow holes as to render it useless. Can this be corrected?

A.—This trouble occurs principally on solid or cored-type piston heads and not on the bull-ring type. The welding operator will often notice as he applies the wear-resisting bronze that hundreds of tiny jets of flame blow through the molten puddle. This is caused by the release of the gas formed from the oil in the pores of the cast iron. This oil, heated by the flame, seems to have a tendency to release itself at the time the puddle is directly over it and makes an unsightly looking welding job. To correct this, heat the area to be brazed to a dull red and allow it to cool. When cool, grind the surface bright and the piston is ready to braze.

Curing A Torch Of Bad Habits

Q.—When a cutting torch develops the habit of snapping, cracking and popping out the only remedy seems to be to apply a new tip, which is expensive. Could you suggest a more economical cure?

A.—The snapping and popping out that you mention is caused by pre-ignition; that is, the gas lights behind the tip instead of at the end where it should. This is usually caused by a loose or ill-fitting cutting nozzle. This is especially true in torches having a flat seat.

When a cutting tip has this defect, test it to see that it is tight in the torch; if it is and it still acts up, remove the tip from the torch and inspect the seat. If the seat is cut or damaged, hold it squarely on a mill file and rub it along the file, turning the tip around before each stroke. This should dress off the tip seat so that it will fit squarely against the seat in the torch. If possible, the seat should be faced in a lathe. When this is done the small circle in the center should be left .001 in. higher than the rest of the seat.

Building Up Worn Stoker Screws

Q.—We have a number of stoker screws of the Duplex elevator type to reclaim. On many of these the edges are worn so thin that it is difficult to weld without burning through. What method is recommended in this case?

A.—Place the worn screws in a lathe and turn the flight to 1¼ in. under the desired finished size. Cut some ⅝-in. square bar stock into 6-ft. lengths. Place the screw on two horses of a convenient height and tack one of the 6-ft. pieces to the bottom of the flight. Heat the square steel with the torch and form it to the contour of the flight, tacking it securely every 10 in. An occasional slight twist with a wrench will keep the bar flat with the machined surface. When the ⅝-in. bar is affixed the entire length, the screw is held in an upright position and the space between the hub and the bar is welded level full. The flight will not burn through because the thin edge has been removed.

Acetylene Welds Over Electric Welds

Q.—Is it possible to make a successful acetylene weld over a previously made electric weld?

A.—It is practically impossible to make an acetylene weld over a bare-rod electric weld. The character of a coated-rod weld is similar to an acetylene weld and if the flux inclusions are not too numerous, a fair torch weld can be made over one of the coated-rod variety. The best method is to remove all arc-weld material before attempting to reweld, even if this makes it necessary to form a small new section from bar or plate stock.

Repairing Injector Bodies By Welding

Q.—When welding worn or cracked injector bodies, what can be done to keep the body from cracking? Invariably this happens in building up an injector body.

A.—Injector bodies like any similar thin casting must be preheated before welding to make a good job. If the body is cracked, chip the crack out with a sharp chisel, taking every precaution to avoid breaking out large pieces of the body. When the inspirator is worn from contact with the jacket, cab or pipes, clean the areas to be brazed free from all dirt and scale. With a large tip in the blow pipe heat the injector slowly and evenly until it is sizzling (about 600 to 700 deg.) quickly change to a small tip and complete the bronze welding. The metal in the average injector body lends itself readily to welding. As soon as the welding is completed change again to the large tip and reheat the entire casting. If the tubes were not removed from the injector, the welder should warn the mechanic repairing it that the tubes may be loosened from the welding heat and he should check them before assembling.

Welding Torch Tip For Driving-Box Work

Q.—What size welding tip should be used for brazing driving boxes?

A.—It is difficult to state the size welding head, or tip, needed because each manufacturer has a different method of numbering. However, a welding head with an orifice of about $\frac{3}{32}$ in. using between 100 and 125 cu. ft. of acetylene per hr. is effective. Some operators prefer a larger flame than others but too large a flame tends to burn the applied metal and render it less efficient.

Locomotive Boiler Questions and Answers

By George M. Davie

(This department is for the help of those who desire assistance on locomotive boiler problems. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless special permission is given to do so. Our readers in the boiler shop are invited to submit their problems for solution.)

Imperfections in Boiler Plate

Q.—What allowance for imperfections should be permitted in accepting boiler shell plates?—M. E. F.

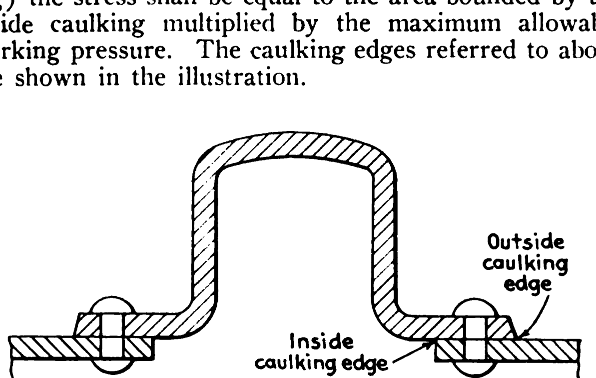
A.—All boiler shell plates should conform strictly to the specifications to which they were ordered. Check analysis for each plate should be made of the chemical composition of each melt of steel used in making the plates. A tension and bend test should be made from each plate as rolled. The furnished material should be free from injurious defects and have a workmanlike finish.

The A. S. M. E. Boiler Construction Code provides as follows in connection with imperfections in boiler plates: All plates should be examined for surface defects, such as scale, depressions and laminations. Plates may be accepted having depressions not over four inches in length or a depth not exceeding 15 per cent of the thickness of the plate, if upon careful measurement of the depressions it is found that the reduced thickness does not leave the plate weaker than where machined for rivet holes or tube holes. Plates that are found laminated shall be rejected.

Determining Load on Auxiliary Header

Q.—We are applying an auxiliary header to several of our locomotives. The header is of flange steel and is riveted to the shell of the boiler. In determining the required number of rivets for securing the header to the shell, is the load on the rivets taken as the boiler pressure times the area of the rivet circle?—F. E. R.

A.—In determining the required number of rivets for securing a header to the shell, the stress on the rivets shall be obtained by multiplying the area bounded by the outside caulking multiplied by the maximum allowable working pressure, where the caulking is on the outside edge of the header. Where the caulking is on the inside edge of the boiler shell (and with no outside caulking) the stress shall be equal to the area bounded by the inside caulking multiplied by the maximum allowable working pressure. The caulking edges referred to above are shown in the illustration.



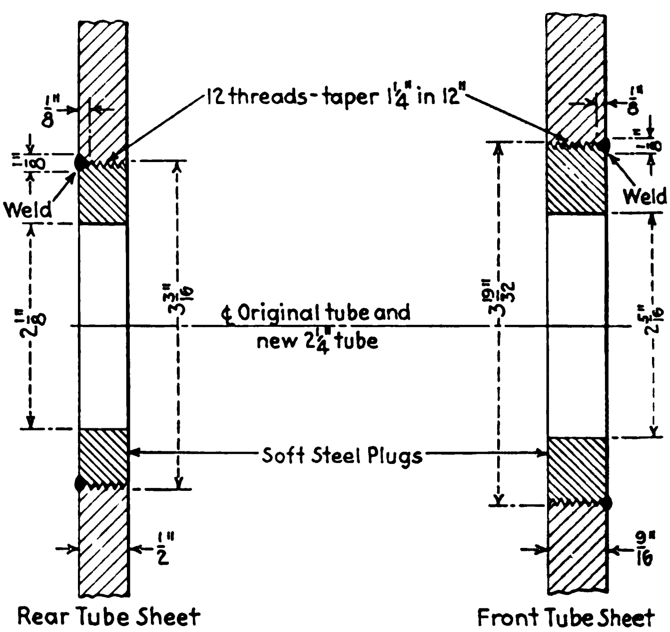
Caulking edges on auxiliary header

Preparing Tube Sheets for Application of Smaller Tubes

Q.—In applying a firebrick arch to several Mikado locomotives, it is necessary to reduce the size of two of the lowest tubes from 3½-in. to 2¼-in. outside diameter tubes. Would you recommend a method of altering the front and rear tube sheets to make this change?—S. B.

A.—The illustration shows one method of altering the front and rear tube sheets of a locomotive boiler when replacing 3½-in. with 2¼-in. outside diameter tubes in the same locations.

The alteration consists of tapping out the original holes in the tube sheets, using a tap with 12 threads per



Method of applying steel plugs to tube sheets for reducing size of holes to take smaller tubes

inch tapered 1¼ in. in 12 in., and applying soft steel plugs screwed in and welded all around. The holes should be plugged preferably from the water side. Plugs are then drilled for application of the 2¼-in. tubes as illustrated.

Distance from Back Head to First Row of Staybolts

Q.—We have several Mikado type engines operating at a pressure of 225 lb. per sq. in. We intend to replace the fireboxes in these engines using welding seams in place of riveted seams. The question has arisen as to the distance from the knuckle of the backhead to the first row of staybolts adjacent to the knuckle, both for the crown and sides of the backhead. Should the same staybolt layout be used with the welded firebox as with the riveted firebox?—C. H. D.

A.—The general practice where templates are not available is to lay out the new firebox sheets using the old sheets as templates, thus assuring proper alinement of the staybolts in the new firebox with old holes in the wrapper sheet and backhead.

When butt-welding the firebox door sheet to the crown and sides, it is preferable to have the welded seam between two rows of staybolts as illustrated in Fig. 2. With this type of construction, the sheet is supported on both sides of the weld by the staybolts. This would also be true for the seam between the firebox tube sheet and the crown and sides. The distance from the knuckle of the door sheet to the first row of staybolts adjacent

to the knuckle on both the door sheet and the crown and sides would remain the same for both riveted and welded construction.

The A. S. M. E. formula for determining the pitch

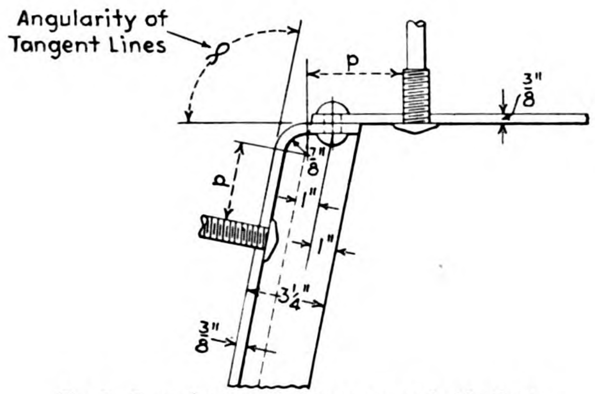


Fig. 1—Door sheet applied to crown and side sheets by riveting

from the staybolt next to the corner to the point of tangency of the corner curve, see Figs. 1 and 2, is as follows:

$$p = \frac{90 \sqrt{C \dfrac{T^2}{P}}}{\text{Angularity of tangent lines}}$$

where

p = Maximum pitch, in. (see Figs. 1 and 2).
T = Thickness of plate in sixteenths of an inch.
P = Maximum allowable working pressure, lb. per sq. in.
C = 125 for stays screwed through plates not over 7/16 in. in thickness with ends riveted over.

Assume the angularity of the tangent lines to be 115 deg. and the thickness of plates 3/8 in. The maximum pitch as shown in Figs. 1 and 2 for a pressure of 225 lb. per sq. in. would be

$$p = \frac{90 \sqrt{125 \times \dfrac{(6)^2}{225}}}{115}$$

$$p = \frac{90 \sqrt{125 \times .16}}{115}$$

$$p = \frac{90 \times 4.47}{115} = 3.5 \text{ in.}$$

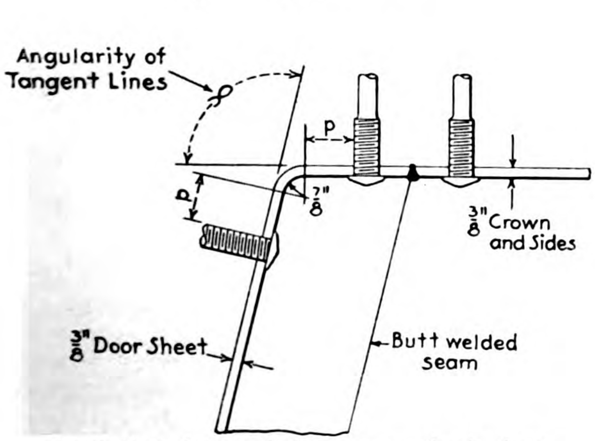


Fig. 2—Door sheet applied to crown and side sheets by welding

Cemented-Carbide Tool Grinder

The illustration shows a grinder made by Thomas Prosser & Son, New York, for the reconditioning of all types of single-point tools including those of cemented carbide, stellite or high-speed steel. It is equipped with two quick-acting tables with graduated indexes which permit setting the tool to any desired angle. The tables can be almost instantly adjusted to the required angle due to the construction and location of the pivot point in the same plane as the surface of the wheel.

The motor is reversible so that either right- or left-hand tools can be ground with a wheel rotating toward the cutting edge. The grinder is equipped with a brake for quickly stopping the machine and saving time when changing the direction of rotation. The brake is fitted with a replaceable brake shoe. The motor has a speed

The Prosser cemented-carbide tool grinder is equipped for the accurate grinding of single-point tools

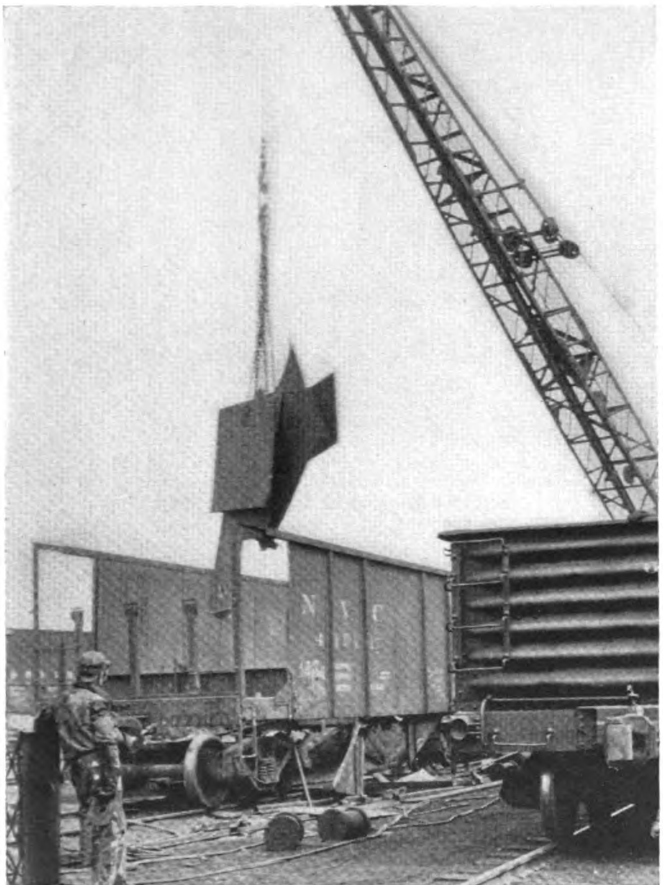
of 3,450 r. p. m. for maximum grinding efficiency with both the 7-in. silicon-carbide wheels and the 6-in. diamond wheels.

The grinder was designed especially for the use of either diamond or silicon-carbide cup wheels. The combination of a silicon-carbide wheel for roughing and a diamond wheel for finishing is often used, although more and more diamond wheels are being used for roughing. When a diamond wheel is ordered with a machine, a special lubricating device is furnished for the proper lubricating and cooling of the wheel surface while grinding. The silicon-carbide cup wheels are mounted on steel backing plates and their location on the shaft is adjustable to compensate for wheel wear. An adjustable light is installed for the proper illumination for the work on either table.

Freight-Car Shop Methods

At the Beech Grove, Ind., shops of the New York Central, the progressive or straight-line method of repairing freight cars is used with some modifications to adapt it to local shop conditions. The present program of work includes the making of heavy repairs to a series of 50-ton hopper cars and to a series of 40-ton wood-sheathed steel-underframe box cars. An output of eight hopper cars and eight box cars a day is now being secured with a force of approximately 350 men in the freight car department. While there is nothing strikingly new about the straight-line method used in repairing them, a number of shop tools, methods and devices seem worthy of special comment.

In stripping the hopper cars, for example, at the first position on tracks outside the steel car shop, the corroded, sides, ends, hopper sheets, floor sheets, etc., are stripped from the car and moved by a locomotive crane into the adjacent scrap car with a single operation which is believed to be unique. This method saves a great amount of hand labor and time, as well as contributing to safety and a generally clean and well-picked-up condition along the repair tracks, even at the stripping position.

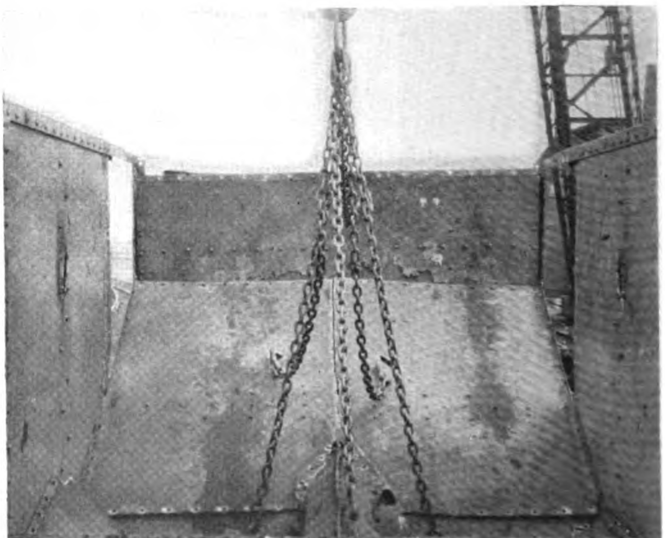


Sheet sections, pulled loose from the hopper car, are being moved to the scrap car with a single lift of the locomotive crane

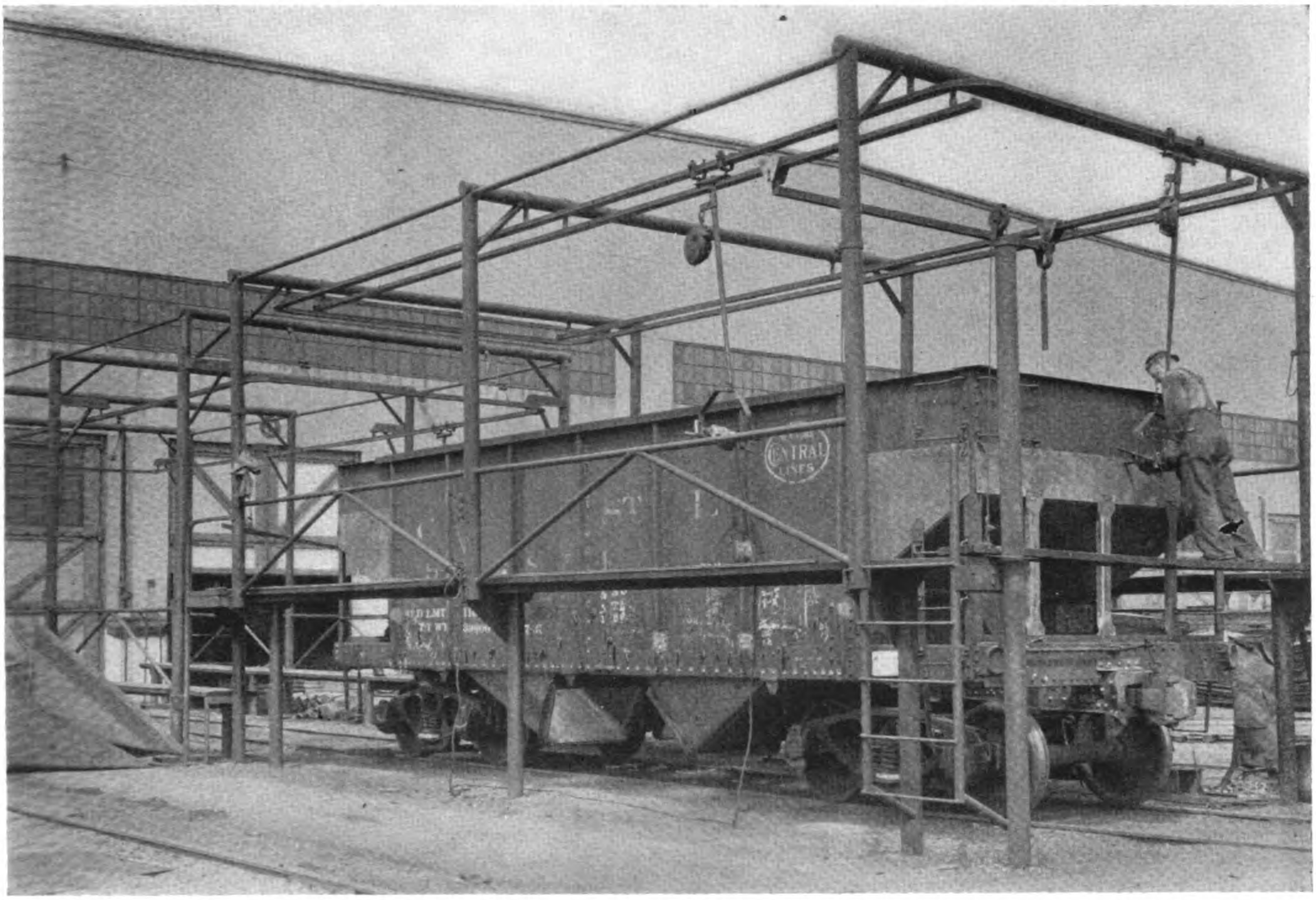
The first operation in stripping steel hopper cars consists of burning out the rivets which hold the corroded sheets to be replaced. In this work, experienced operators using oxy-acetylene torches with special rivet-cutting tips burn through the centers of the rivet heads and melt out the rivets without any damage to surrounding sheets. Three or four rivets are left in each sheet with just the heads burned off so as to hold the sheet temporarily in place, but permit it to be jerked loose with an easy pull from the locomotive crane. In a few inaccessible places where there is not room to manipulate the cutting-torch head, rivets may have to be backed out. A triangular hole is cut near the center of each sheet for attachment of the crane hook.

When everything is ready, a locomotive crane and scrap car are moved to a track alongside the stripping position. The large crane hook is equipped with an auxiliary six-way chain, having a small hook at the end of each of the 6-ft. chain sections. The crane cable is lowered until each of the six-way chain hooks can be inserted in one of the V-slots in a hopper-car sheet section, as shown in one of the illustrations. Operation of the crane then, in one upward movement, pulls loose six sheet sections which continue their upward movement until clear of the car sides when they can be readily swung over and dropped in the scrap car. Four lifts are usually adequate to strip a hopper-car floor system complete which includes the hopper sheets, floor sheets, longitudinal hoods, cross hoods, end sheets, etc.

Typical of the labor-saving methods and equipment used in actual car repair and assembly operations at Beech Grove shops is that shown in one of the illustrations where a hopper car is located under a special steel pipe framework and all reaming is done with high-cycle electric tools. In this case, each tool is supported in a counterbalanced frame which gives complete flexibility



Six-way chain with hooks engaging individual sheet sections ready for removal of the sheets with a single lift



Special equipment used at reaming position to permit easy and safe one-man operation of electric or air-operated tools

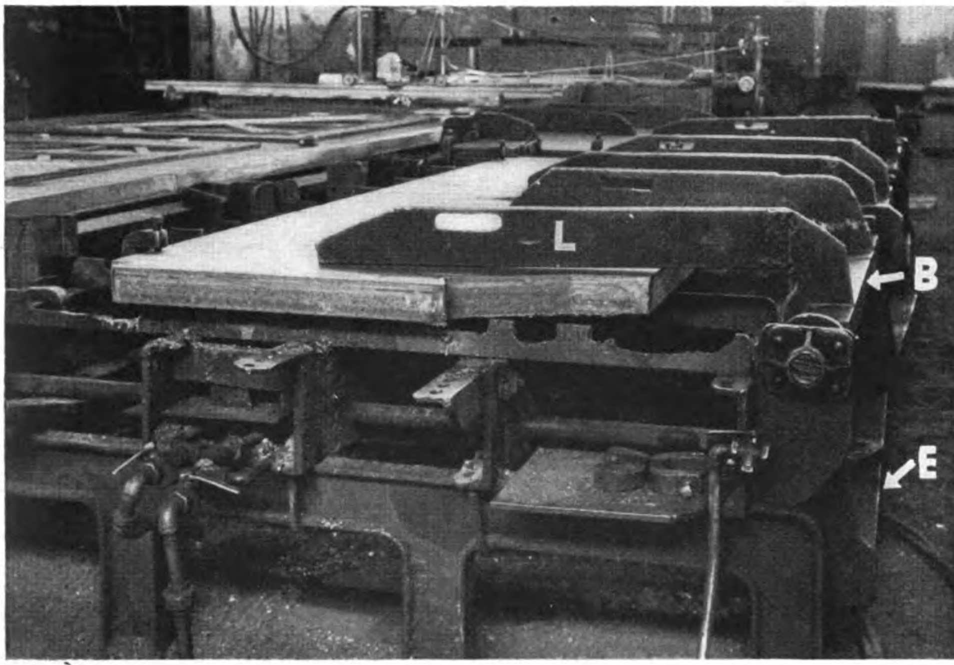
of movement of the motor-driven reamer, both longitudinally, vertically and inwards and at the same time supports the reamer handles so that the operator is in no danger of losing his balance and being knocked off the scaffold in case the reamer sticks and the handles have a tendency to turn unexpectedly, with full power on.

The framework at the reaming position consists of 5-in. and 2-in. scrap superheater flues which are unsuitable for further use in locomotive boilers but are still amply strong for structural purposes. Their framework is 36 ft. long by 18 ft. wide by 32 ft. high and it will be noted that two reaming positions are provided. The main vertical supporting posts are mounted in substantial concrete footings outside the repair track and carry a scaffold or platform 6 ft. high on either side of the car, supported as shown in the illustration and equipped with a 2-in. guard rail. A welded steel ladder gives easy access to each platform.

The upper part of the 5-in. pipe frame serves as a support for an overhead track made of 2½-in. by 3-in. T-iron and arranged so that two balancers are readily traversed around the track for reaming from the outside of the car and two additional balancers for inside reaming. Each balancer consists of a telescoping arrangement which gives a 6-ft. vertical movement and counterbalances the weight of the motor by means of a spring suspension at the top and a wire cable. At the point of application of the electric motor, a bracket made of 2-in. bar iron is attached to the balancer and supports the electric motor by means of the two handles, adding to full safety for one-man operation.

End scaffold boards for reaming the car ends are supported by two cables with counterweights inside the pipes so the boards may be readily raised or lowered by one man. These boards are equipped with guide plates which keep them in position and enable them to be easily elevated whenever it is necessary to move a car in or out of the reaming position. Electric connections are provided at each center post so that the operator does not have to get down from the scaffold to plug in his electric motor. The view of the reaming position included with this article shows an operator on the end scaffold board reaming an end sheet which has been partially renewed.

Inside the steel car shop, a flame-cutting machine, shown in another illustration, is used to good advantage in the cutting of stacks of steel sheets to specified patterns and shapes. Referring to the illustration, the template or pattern which is used in guiding an extension of the gas-cutting head of the machine is bolted to the table at the left. The steel sheets to be cut are stacked in groups of twelve ¼-in. sheets, for example, which are supported on the metal framework in the right foreground of the picture. The stack edges are firmly held together by C-clamps and each stack is itself held rigidly in place on the work table by air-operated lever clamps, one of which is marked *L* and shown prominently in the illustration. These lever clamps are adjustable in position along the operating bar *B*, to suit the length or size of the material being cut. They are made of 1-in. by 4-in. bar iron, arranged with a wrench end at the right to fit around the 2-in. by 4-in. bar *B*, which can be revolved slightly by lever connection from an air cylinder beneath the work table. The bottom equalizing lever is shown at *E*.

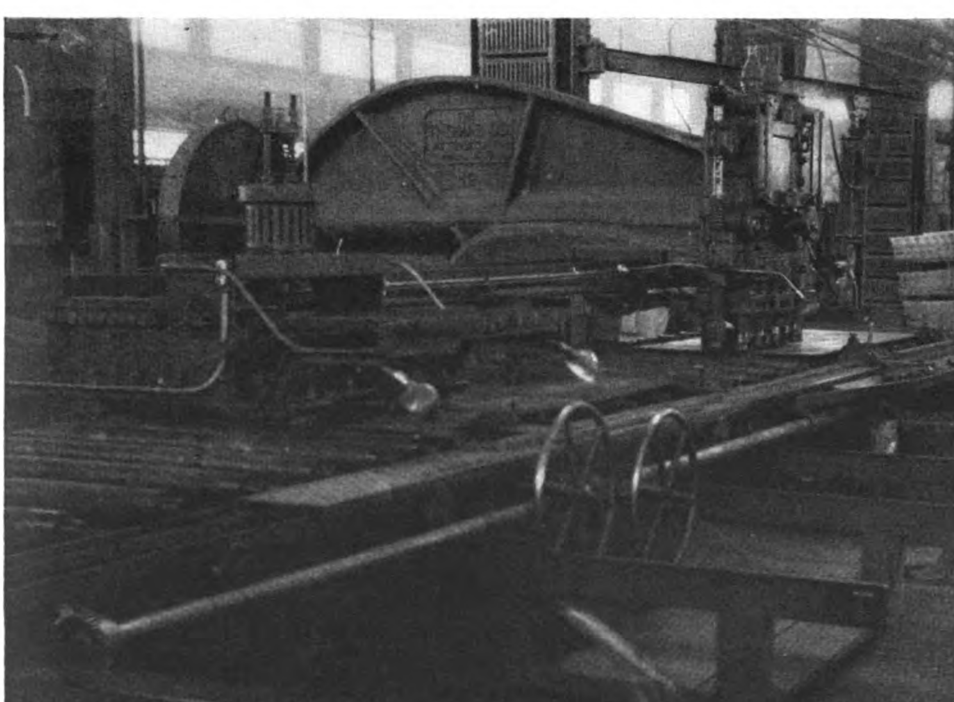


Air-operated lever-type clamps used in holding stacked car-sheet sections on work table while being flame-cut to desired shapes

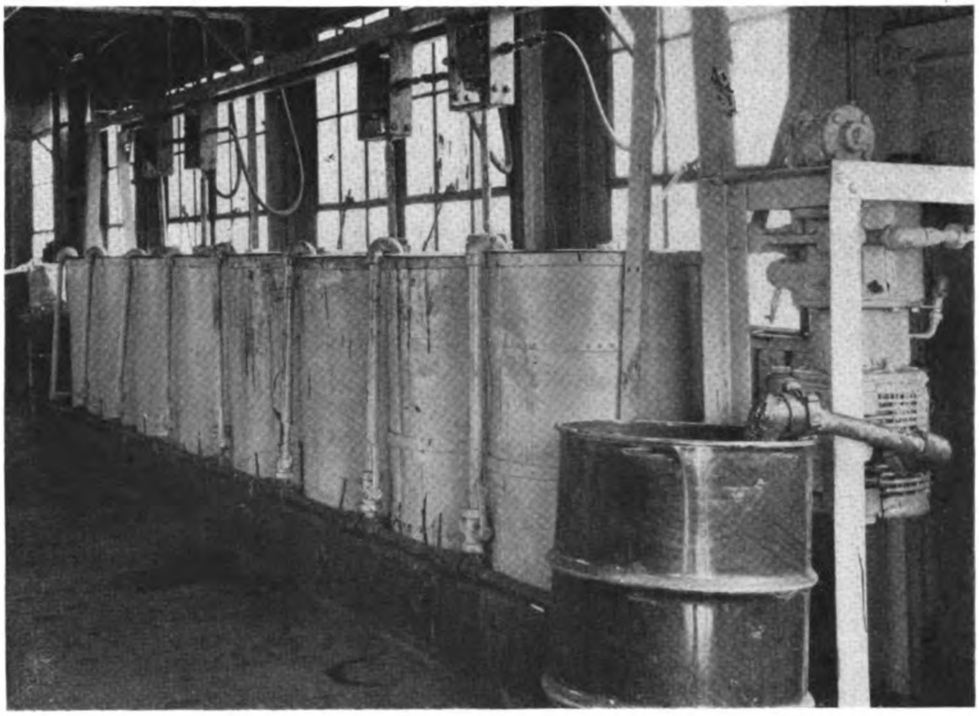
When the stack of sheets has been properly located on the work table, air is admitted to the cylinder under the table which forces equalizing bar *E* to move to the right. This causes bar *B* to revolve slightly and brings a downward pressure on the center of the stack of steel sheets by means of the clamp levers which hold the sheets firmly during the cutting operation. Subsequent release of the pressure enables the holding levers to be disconnected and the stacked sheets moved to the next position in the fabrication line.

This flame-cutting machine is used in the quantity-production of many steel-car parts, such as hopper sheets, longitudinal hood sheets, cross hoods, floor sheets, etc., as compared with shearing and coping individual sheets, there is considerable saving of time and manual labor in handling. Moreover, material is saved since the scrap pieces cut out with a torch are undamaged and may be used for the production of other car parts of small size, whereas machine coping usually cuts interior material beyond any possibility of further use.

Still another machine which contributes greatly to the efficient operation of the Beech Grove steel shops is the duplicating machine, shown in one of the illustrations. This machine is designed to punch and cope steel sheets ranging in thickness from $\frac{3}{16}$ in. to $\frac{3}{8}$ in., and with holes up to 6 in. round or 6 in. square. A master sheet is simply clamped to the left end of a work



Duplicating machine which punches and copes car steel sections accurately, rapidly and with no re-handling



Paint transferring pump and mixing tanks which assist greatly in efficient paint handling at the Beech Grove Shops

table which carries the sheet to be formed clamped to a gage line on the right end of the table. The operator stands on a traveling platform opposite the master sheet and utilizes one hand wheel for longitudinal and one for transverse movement of the table. Adjusting the master sheet until a finder pin in the head registers with a center positioning hole in the pattern, operation of a foot-pedal switch causes the punch to operate and make a hole of the desired size or shape and at the proper location in the work sheet.

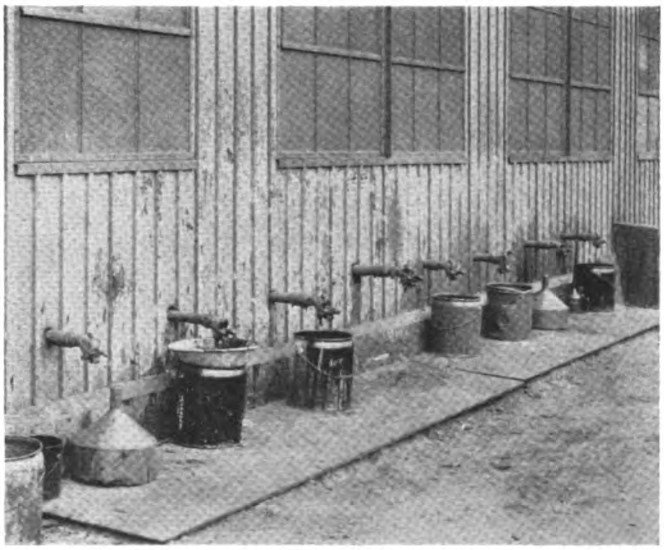
All layout work is thus avoided (except for one master sheet) and maximum accuracy and duplication of desired shapes is secured. Sheets may be handled 6 ft. wide by 12 ft. long. Experience indicates that best results are secured when one sheet is punched or coped at a time. The maximum production with this machine is 36 strokes per min., and it is featured by a central lubricating system, roller-bearing electric control and solenoid operation of the individual punches. The use of the machine saves not only layout time and rehandling time, but assures uniform accuracy in the punched and coped sheets which avoids difficulty in subsequent fabrication.

One feature of the work at Beech Grove freight carshops which is not particularly new but has shown excellent results is the equipment used in storing and mixing paints in a clean, warm paint house, with access to the paint supplies available from the outside, as shown in the illustration. All of the painting operations in connection with freight-car work involve the use of paint-spray equipment, and the paint-spray tanks may be filled from the outside without the necessity of going into the paint house.

Referring to the interior view of the paint house, there are eight paint tanks of 100-gal. capacity each, mounted on a concrete base about 12 in. above the floor. A double overhead rail supports four air motors in roller-equipped steel frames which can be moved to desired positions over any four tanks simultaneously and used to drive double-blade agitators in the tanks, thus keeping the paints well mixed. The drive shaft from each motor is easily attached by means of a coupling to the end of the agitator shaft which extends up to and through the steel tank cover. The motor speed is usually adjusted to about 40 r. p. m.

At the right of the illustration, a 9½-in. air pump is shown mounted in a steel frame and used to transfer paint from drums as received from the manufacturer into the mixing tanks. The drum, shown in the illustration, has a capacity of 52 gal., and can be emptied, using this equipment, in about 10 min., without any manual handling. A 2-in. pipe connection is simply made to the air-cylinder intake, the discharge side being connected to the pipe line supplying the series of paint tanks, with shut-off valves available so that the paint may be forced into whichever tank is desired. The pump is then operated, using shop air pressure and no difficulty is experienced in handling any kind of paint except heavy cement which cannot be put through the pump.

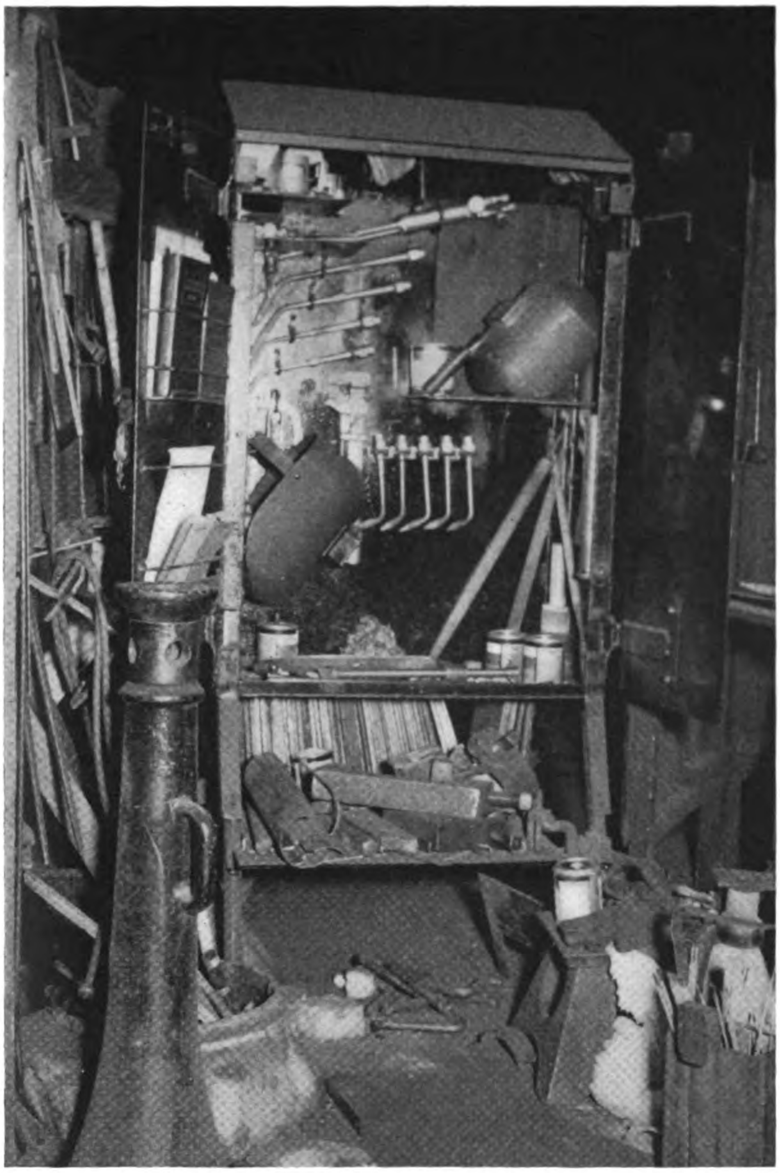
(Continued on page 241)

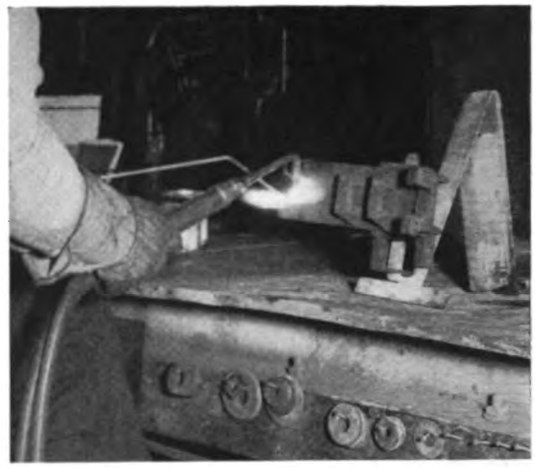


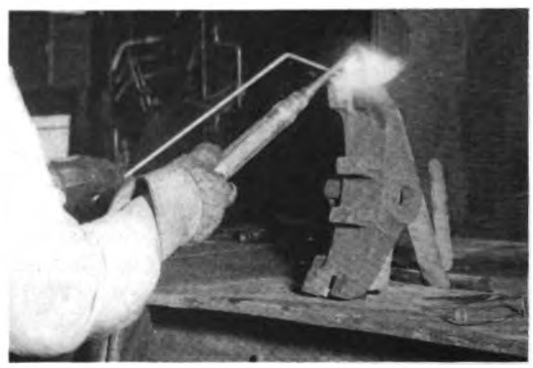
Individual distribution spigots extending through the painthouse wall give easy access to well-mixed paint supplies

Welding Kinks For the Small Car Shop

By Harvey Arthurs







The welder's corner in the shop is decorated with a variety of the implements of his trade. Some idea of the many things that are used by the welder are shown in the storage cabinet in the large photograph at the left.—The two small views above show a very simple device for holding the ordinary brake head while the worn spots are built up by welding. This welding jig is designed so that it will not slide around on the bench while being used

SOME of the methods used and the devices developed for car welding work in a repair shop on a small eastern road are shown in the accompanying photographs and described here. The photograph of the car shop welder's cupboard will give the reader a general idea of the variety of jigs that clutter up the welder's habitat.

A typical welder's job is that of holding a passenger-car truck brake head. Any one who has attempted to build up a brake head will realize the utility of this device. There is no surface on the brake head that is square and, if it is leaned up against something, it is bound to slide off the bench onto the floor. This simple jig is so arranged that it will hold the brake head horizontal for building up the sides of the bosses. It also holds the head upright for building up the ends of the lugs. This jig is a piece of 1/4-in. by 2-in. steel bent to an angle of sufficient height to support the brake head. A heavy piece of steel is tacked to one leg of the angle for weight so that the jig will not slide around on the bench. A small foot is bent on one side to hold the bottom of the head from kicking out and a piece of 1/4-in. by 1-in. iron is welded to the other side. This will slip through the brake pin hole and hold the brake head in a convenient flat position. Wear-resisting bronze is used to build up the worn places on the head and it seems to wear fully as long as the original metal.

On some of the older type passenger and milk cars the cast-iron open-type pedestal is still in use. When these pedestals are removed they are completely rebuilt with bronze. The bronze is applied carefully and checked frequently for size, eliminating subsequent machining.

The regular steel pedestal, when worn, is planed to a size requiring a definite thickness of shim, or plate, that is, 3/16 in., 1/4 in., or 5/16 in. These liners are welded in place and when they become worn they are knocked

off and new ones welded on to replace them. The size required is stamped on the pedestal to save time for the welder. With the size in plain sight he does not have to measure each pedestal before applying the plate.

Passenger-car truck boxes are also reclaimed by bronze welding and are used indefinitely, except for breakage. As is shown in the accompanying photograph no machining is needed, the worn sides of the box are rebuilt with the bronze and checked with the handy gage shown so that they will slip over the pedestal with just the proper amount of clearance.

Truck frames are often found with a serious fracture, sometimes running for several inches. When this condition exists, the fracture is veed out with a cutting torch, care being taken to remove all of the crack. The truck frame is blocked so that it will not warp out of line and the area near the fracture is heated to a dull red. The crack is torch-welded with a mild-steel rod, occasionally passing the torch over the heated area to keep it hot. A slight reinforcement is added to the weld

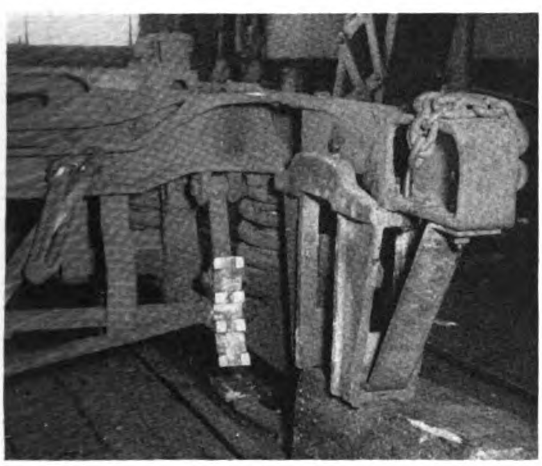
Much of the older type passenger equipment used on the small road offers an opportunity for repair work by welding methods. Below are truck pedestal and brake head reclamation, building up truck boxes by welding and, at the right, a repair job on a passenger car truck frame in which a serious fracture was discovered

and all overflow is washed from the under side of the weld. If possible this side is also reinforced slightly. When the welding is completed the whole section is again heated thoroughly and allowed to normalize.

Another economical welding job is that of building up around the hole in the end of a buffer arm. It is often necessary to fill this pin hole because of excessive wear. Mild steel is used where redrilling is needed and the other worn parts are filled with wear-resisting metal, such as tire steel, applied with a slightly carbonizing flame.

Hundreds of freight-car door rollers are always handy to the welding bench where the welder can fill the holes in a few of these whenever time permits. These cast-iron rollers are drilled and countersunk from both sides previous to welding so that there will be a good bond between the base metal and the applied bronze. The rollers are drilled to size after welding.

On a number of passenger coaches the metal roof rusted through near the junction of the roof and the side panel. The rusted section is removed with a cutting torch, using a small tip and holding the torch almost parallel to the cut. This method of cutting leaves a kerf straight and free from oxide. Sheets of No. 16 gage, of the correct width, are formed in the boiler shop to the correct radius. These pieces are made in 6-ft.



strips and are held in place and tacked with either the electric arc or acetylene process. When tacked every 10 in. or so the welder than back-welds the strip securely in place.

Welding is not used as much in making freight-car repairs, although there is an occasional call for a welder to apply a patch on a hopper door or to rebuild a worn brake post on a truck with stationary brake-hanger posts. On truck sides having removable hanger pins, the pin holes are often worn oblong, sometimes as much as 3/8 in. Due to the construction of these side frames it is an expensive job to fill these holes and redrill them. Therefore, several methods of repairs have been tried. The most successful and economical is to fashion a small piece of steel in the shape of a crescent. The piece should have an inside diameter about 1/32 in. larger than the brake-hanger pin. A substitute pin is slipped in place and the crescent-shaped pieces are inserted in the holes to compensate for the wear. These pieces are then welded as solidly as possible. The substitute pin is now removed leaving the holes true to size. When the hole in the brake hanger is plugged and redrilled the brake beam will be held in its correct position and not be in danger of dropping on the ground.

Terminal Conditioning Of Pullman Cars*

By W. T. Kidwell

In addition to the daily handling of Pullman cars in and out of the yard, the testing of and repairs to air brakes, trucks and running gear, there are such features as car cleaning, maintenance of the lighting and air-conditioning systems, the thousand and one items of hardware that have to be maintained, painting, upholstering, exchange of linen, stocking car with supplies, etc., which the Pullman Company has to worry about.

Pullman cars have to be aired out, rubbish collected and removed; plush, carpet and bedding vacuumized, windows cleaned and interior finish wiped down. The rubber tiling is scrubbed; wash basins, hoppers, metal work and hardware are cleaned and polished. Linen is exchanged and car supplies checked.

At certain periods the cars are given special strip cleaning when bedding, seats, seat backs, etc., are set aside, and the car thoroughly blown out with compressed air. Also, as parts of the inside finish show signs of dullness the woodwork, headlinings and bunklinings are thoroughly washed and chamoised, and certain parts polished with wax. The carpet is removed and blown with compressed air. Blankets, mattresses and pillow covers are exchanged and those removed sent out for special cleaning. Upholstering is carefully inspected and repaired. Painters are constantly at work refinishing damaged or faded parts of the inside finish.

Lighting and Power

When the car leaves a terminal the lighting equipment is on its own. If something went wrong there would be no one, in most cases, available to make repairs until the car reached the end of its run. To furnish ample power and steady lights the equipment must be fully automatic. It must receive inspections and periodical attention during the yard layover to assure its good operating condition. The power is provided by a belt-driven generator and battery located under the car, controlled by regulators usually located inside the car. It operates the same as an automobile system, the generator furnishing power for the lights, fans, electric razors and other electric appliances, and for charging the battery while the car is running. When the car is standing the battery furnishes power for these devices.

The battery must be inspected for loose connections, proper ventilation and the box cleaned out. Water has to be added occasionally, the same as in an automobile battery. Generator brushes wear out, get stuck with dirt; bearings develop defects and have to be replaced. The belt has to be inspected for wear and other conditions, and has to be replaced from time to time. Generator suspensions, pulleys and belt tension apparatus must be inspected for defects. Regulators use carbon discs and are affected by dust, overheating and adjustments, and require checking at regular intervals. These are all items the car lighting man must check up on in addition to seeing that the wiring is not grounded, repairing switches, changing burnt-out bulbs and various other details inside of the car.

Air Conditioning and Winter Heating

If the generator or battery fails, power for the lighting system can be obtained temporarily from an adjoining car by connecting the two with a train-line connector provided for this purpose, but there is no similar means of getting cooled air when the air conditioning apparatus fails. Inspection of this apparatus is therefore doubly important. These systems consist essentially of an air circulating system including apparatus for keeping the air in motion, cooling, heating, filtering and dehumidifying. The cooling apparatus being the principal parts may be one of several mechanical types, or a steam ejector or an ice system, all in common use on Pullman cars, and operate much the same as household refrigerators except on a larger scale.

This apparatus is also fully automatic and only the closest attention at terminals by skilled maintenance men can provide the necessary assurance that it will operate properly throughout the trip. There are many operating parts that wear out and get out of adjustment. Various kinds of lubricants are used periodically. Air filters, strainers, condensers, motors, speed controls and various control boxes have to be cleaned. Operating pressures, the adjustment of pressure switches and thermostatic valves require close and careful checking while the car is laying over in the yard. These, together with many details of lesser importance, keep the air-conditioning maintenance man always on the alert if he is to be a successful trouble shooter.

It is the cooling equipment in the summer and the heating equipment in winter that he has to worry about. Along with air conditioning came the automatic control of temperature within the car when heat is required. This has progressed along with other features developed by the car builders. The passenger riding in the later type cars today can set the temperature in his room to suit his individual idea and this temperature is maintained automatically. There are 45 automatic steam valves and 21 heating thermostats on the latest type of roomette car. In addition to this there are an equal number of relays, control switches, and the necessary wiring to complete this system of control. There is much of this apparatus to be looked over and repaired while the car lays over in the yard.

The hardware in a car is something else that meets the eye—and a passenger is quick to complain if some-

* Abstract of a short paper presented before the March 18 meeting of the Car Department Association of St. Louis. Mr. Kidwell is yard foreman of the Pullman Company at St. Louis, Mo.

thing doesn't work right. Such items as door locks, handles, hinges, holders and checks, subject to severe service, require considerable attention. Water faucets must always provide a liberal flow of water, and not leak; basin drains must be kept clean so water will drain out quickly. There is the water raising system with its automatic air-pressure control valves, filling valves, strainers, etc., that have to be looked after.

Hopper valves, especially on newer cars where the hopper folds back into a small cabinet, are highly complicated pieces of mechanism and subject to such defects as those caused by small grains of sand lodging on the valve seat, getting out of adjustment, worn gaskets, etc. Window glasses and mirrors get broken; window shades get out of fix, screws come loose that may catch and tear a passenger's clothing. These, together with hundreds of smaller items of hardware on a car, require the constant attention of highly skilled mechanics.

The casual observer hasn't the slightest conception of what is required in the way of yard maintenance to present a car in neat and orderly appearance, with all the facilities provided and functioning properly for his use and comfort. Were he to step into a railroad yard and watch the maintenance organization board the car and look after their work, to say he would be amazed is only putting it mildly; but it is a vital part of the Pullman service, and it is only a part of the whole job because, as all of you know only too well, the part your organizations take care of is equally voluminous and complicated. All of us, if we are to work together smoothly and efficiently must know something of the other fellow's job. What we are providing for the railroad passenger is something he accepts as a single unit when he buys his ticket, and to produce this successfully we must work as a single unit.

Beech Grove Freight-Car Shop Methods

(Continued from page 237)

The paint at the bottom of each drum is usually thinned out slightly to make sure that it will flow freely. Exclusion of air from the paint cylinder avoids any possibility of the paint drying on cylinder walls or piston packing grooves and thus making the pump inoperative.

The use of this paint pumping equipment saves much handling of heavy paint drums, and the distribution of the paint at the outside spigots is found to save time and promote cleanliness in the paint house. Drip buckets are used to avoid waste and keep the outside grounds clean. Paint supplies are always easily available and are kept in a well-mixed, warm and easy-flowing condition, the latter being a particular advantage in winter when low temperatures prevail.

Spectacle-Type Safety Goggle

An on-center safety goggle of the spectacle type has been announced by the American Optical Company, Southbridge, Mass. The features of this goggle include a double-braced bridge developed for hard usage, a design that conforms to the orbit of the eye, comfortable rocking pads and insulated, heat-resisting temples that are perspiration proof. The goggles are available in three eye and bridge sizes. They are equipped with Super Armorplate clear or Calobar lenses.

On-center safety goggle made by the American Optical Company—It can be equipped with wire-mesh side shields

In addition, this goggle can be obtained with wire-mesh side shields which give extra protection against particles striking from the sides. These screens are non-corroding and easily cleaned.

* * *

A neat and impressive safety first board which first greets the eye on entering the Beech Grove, Ind., shops of the Big Four

High Spots in
Railway Affairs . . .

Daniel Willard Made Chairman

"Uncle Dan" Willard, as he is familiarly known, was advanced to the newly created office of chairman of the board of the Baltimore & Ohio at the end of April, when at 80 he resigned the presidency to which Roy B. White, president of the Western Union, succeeded. Few railroad executives, if any, have made such a deep place for themselves in the hearts of railroaders, as well as of the general public. He is listened to attentively in Washington, both by the Administration and on The Hill. He is held in high regard by railway executives, even though he has a mind of his own and knows how to fight—and fight hard. He rates high in the minds of railroad workers. Few executives have had so varied an experience in climbing from the bottom of the ladder to the highest rung. Mr. Willard has an unusually keen appreciation of the importance of good public relations, as well as good employee relations. Certainly he has understood how to appeal to the public mind and sell his railroad, as well as railroading in general. He demonstrated the value of pageantry to that end in the celebration of the centenary of the Baltimore & Ohio in 1927. Summoning Ed Hungerford, with his rare gift of showmanship, they staged The Fair of the Iron Horse at Halethorpe. During its existence of only 21 days, a million and a quarter people flocked to its gates. It proved to be the forerunner of The Wings of a Century at the Chicago Exposition, and Railroads on Parade at the New York World's Fair.

Lord Stamp Killed

The "strafing" of Britain was brought home more keenly to Americans, and especially to railroaders, in the loss on the night of April 16 of Lord (Josiah) Stamp, chairman and president of the executive committee of the London Midland & Scottish Railway, and an internationally known economist. He was killed instantly in a Nazi air raid, at his home in Kent, a suburb of London, together with Lady Stamp and their eldest son. Only a little more than a month before, on March 7, he had presided at the annual meeting of the L. M. S. On that occasion he paid a high tribute to the late Lionel Hichens, a director of the company, speaking of him as "another victim on Hitler's murderous list." Lord Stamp was not born a member of a titled family, but started his career at 16 as a minor civil service clerk, and for 23 years remained in government tax work. During his spare time he studied at the London University, finally winning his doctorate. He was knighted for his service on income tax problems and represented Great Britain in drafting the Dawes and Young Plans in 1924 and 1929, respectively. In 1938 he was raised to the peerage. Lord Stamp did much to transform the L. M. S., by bringing a scholarly approach to its problems. This is well illustrated by the establishment in 1930 of a department of research, with a vice-president in charge, and also by the organization of free evening classes for employees, and then the establishment of the School of Transport for railroad officers.

The Safety Problem

Accidents have been on the increase in industry and transportation as production has been speeded up for war materials and to meet the demands of our national defense program. The exposure possibilities have been very greatly increased; at the same time new and untrained workers have been taken on in large numbers. One industrial community has even found that the increase in traffic accidents has been due very largely to the increased number of workers motoring back and forth between their homes and jobs. Loss of time and material caused by preventable accidents is just as serious as that caused by sabotage. The experience on many railroads has indicated that it is possible largely to reduce accidents if adequate accident prevention programs are aggressively promoted. Is there any good reason why the roads in general cannot approximate the high standard of performance of those that are now in the lead?

Railroad Research In Time of War

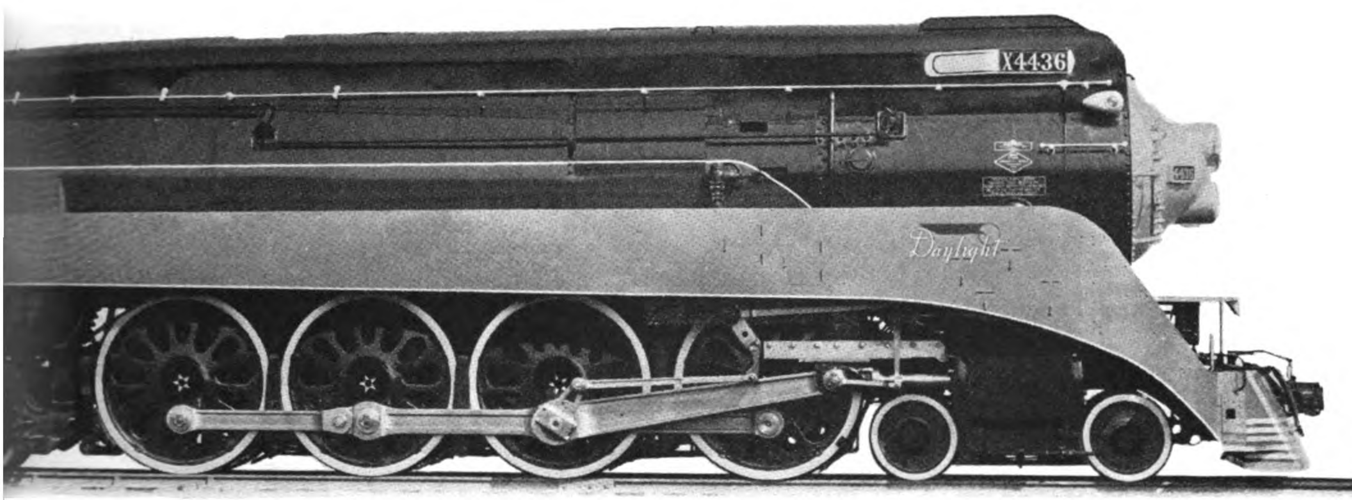
The late Lord Stamp of the London Midland & Scottish Railway, was justly proud of the research department he established on that road in 1930. In his address, as chairman at the annual meeting of the L. M. S. in March, he referred to its adaptability to war requirements. "Wartime conditions," he said, "have given rise to many problems on which the work of our research department has been of very great value. This is a scientific war, and such problems as substitute materials, salvage, A. R. P. (Air Raid Protection) and blackout can only be solved quickly and effectively by scientific methods. Research in government establishments can suggest general solutions, but your organization benefits greatly in having its own department to adapt these general principles to its particular needs. Let me give you two examples. Signal boxes must remain in action during air raids, and you know the danger from flying glass. The research department began work on this problem before the war, and when the need arose we were able to treat the windows of our signal boxes so effectively without interfering with clear vision, that in boxes so treated we have not yet had a single man injured by glass splinters. In one case the signalman was literally wrapped in glass without being scratched. You can guess what this has meant to the confidence of the men and, therefore, to operating efficiency. Then the innumerable lighting problems of the blackout in goods sheds (freight houses), marshalling yards (classification yards), and elsewhere have been tackled jointly by our lighting section, and the research department, and scientific methods have enabled us to combine safety from observation with the best permissible lighting."

"Gadgets" and The World War

Were it not for the seriousness of the situation in Britain, and particularly in London, one could get a real laugh from some of the discussions in our British contemporary, the Railway Gazette. So far as the appearance of that paper is concerned, one would hardly imagine that it was published in the focal spot of the World War. In spite of the toll that the war is taking, we find alongside of articles and editorials on the railways in the war, the same sort of pithy comment about ordinary details as in pre-war days. A typical instance of this is the fact that on one of its editorial pages containing a discussion of "Railways in the War Effort," there is a shorter comment on "An Irrepressible Word." "We thought," says the Railway Gazette, "that the word 'gadget' had relapsed into the obscurity in which we hope in due course will bury other elastic terms of ephemeral value, such as 'Blitz,' 'Molotov' and 'axis,' and are glad that the Air Ministry has given a lead toward its suppression by ascribing the growing toll of enemy night bombers to 'other devices,' which effectively conveys 'gadgets' to the unlearned mind, without shocking the sense of euphony." Then it makes this peculiar statement: "It is a misfortune of the railways that their most commonplace equipment remains perpetually novel and surprising to a large section of the public." American railroad men might well regard this latter fact as fortunate, rather than unfortunate. Certainly the American railroads owe a great deal to the so-called railroad fans, who boost for them, in season and out of season, and to whom no detail of railroading seems to lose its novelty and appeal.

(*Turn to second left-hand page*)

GREATER HAULING CAPACITY...



20 new *Daylights* being delivered by LIMA to the Southern Pacific

These twenty new and improved DAYLIGHTS bring the total fleet up to forty of this type of Super-Power Streamlined Steam Locomotives that have been built by Lima for the Southern Pacific. The Locomotives will be used to power the new "Overnight" passenger trains that the Railroad has inaugurated between San Francisco and Los Angeles as well as the famous "Daylight" trains between the two cities. In addition to passenger service, these Locomotives will also be used to power the overnight "Hotshot" freight that the Southern Pacific has so successfully been using to reclaim LCL freight.

The Southern Pacific has recently placed an additional order for ten more of these locomotives which will bring the DAYLIGHT fleet up to fifty high-speed Super-Power Lima-built Locomotives.

INCORPORATED, LIMA, OHIO

NEWS

A. A. R. Appropriates $83,000 for Counterbalance Tests

DIRECTORS of the Association of American Railroads at their April meeting in Washington, D. C., approved a recommendation of the Mechanical Division and appropriated $83,000 for tests of counterbalances for locomotive wheels. The location of the tests has not been determined, but it was stated that they should be conducted at some point where there would be available 20 miles of "reasonably straight" track, including five miles of tangent.

Symposium on Railway Motive Power for A. S. M. E. Meeting

Several papers on the design, operation, utilization, etc., of steam, Diesel-electric, and electric locomotives give promise of particularly interesting Railroad Division sessions during the semi-annual meeting of the American Society of Mechanical Engineers to be held at the Hotel Muehlebach, Kansas City, Mo., Monday, June 16, to Thursday, June 19, inclusive. For these sessions on Tuesday, June 17, the following program has been arranged:

Comparison of Operation of Steam vs. Diesel-Electric Locomotives in Railroad Service, by E. E. Chapman, mechanical assistant, Atchison, Topeka & Santa Fe.
Modern Steam Passenger Locomotive—Research and Design, by P. W. Kiefer, chief engineer motive power and rolling stock, New York Central.
Utilization of Steam Passenger Locomotives, by A. A. Raymond, superintendent fuel and locomotive performance, New York Central.
The Modern Steam Locomotive in Freight Service, by C. E. Pond, assistant to superintendent motive power, Norfolk & Western.
Electric Locomotive Operation, by H. C. Griffith, electrical engineer, Pennsylvania Railroad.
Advance in Locomotive Tender Design, by M. C. Haber, mechanical engineer, Research and Mechanical Standards Department, Union Pacific.

Other divisions contributing to the technical program for the semi-annual meeting are Power, Process Industries, Materials Handling, Fuels, Hydraulic, Heat Transfer, and Management. The Engineers' Council for Professional Development is also sponsoring a series of sessions on topics of broad professional import.

Sir Nigel Gresley

SIR Herbert Nigel Gresley, chief mechanical engineer of the (British) London & North Eastern since 1923 and locomotive engineer of its predecessor the Great Northern from 1911 to 1922, died at Hertford, England, on April 5. Sir Nigel, as he has been known in recent years, had an unusual career. It began at the Crew Works of the London & North Western where he served his apprenticeship under the late F. W. Webb. He later served under Sir John Aspinall and H. A. Ivatt whom he succeeded as locomotive engineer on the Great Northern. His experience included the supervision of the test room on the Lancashire & Yorkshire at the Harwich shops, locomotive running shed foreman, outdoor assistant in the carriage and wagon department, assistant works manager and assistant superintendent of the carriage and wagon department. In 1905, he entered the service of the Great Northern as carriage and wagon superintendent, from which position he succeeded Mr. Ivatt as locomotive engineer.

The contributions to railway engineering for which Sir Nigel is best known are the three-cylinder single-expansion locomotive which he long championed and the combination valve motion by means of which the two outside valve gears provided motion for the valves of all three cylinders; the development of the Pacific type to accommodate wide fireboxes and large grate areas and extensive, though ultimately unsuccessful, experimentation with a high-pressure water tube boiler. He had much to do with the development of high speeds in England; the streamlined "Silver Link" locomotive, designed for the "Silver Jubilee" train, has to its credit on a special run a speed of 112 m.p.h. On its regular run it made 232 miles in four hours.

In the field of rolling stock, Sir Nigel is best known for the development of the double-bolster trucks now standard under L. & N. E. passenger cars and of the system of articulation in which two or more car bodies are carried on three or more trucks. He also is said to have introduced electric cooking on trains in England.

Sir Nigel was long an advocate of the establishment of a locomotive testing plant in England, and it said that he had made some progress in gaining acceptance for the idea, which the advent of the war swept away.

Baldwin Delivers Its First Army Tank

THE first medium M-3 combat tank built by the Baldwin Locomotive Works was put through its paces on April 23 in a special ceremony at Eddystone, Pa., and turned over to Major D. N. Houseman, executive officer, Philadelphia Ordnance District, by Vice-President W. H. Winterrowd. Before a body of distinguished guests and under the shadow of two eight-in. railway guns recently built by Baldwin, Number one tank ran 30 m. p. h. on the test track. Among other demonstrations of efficiency it was braked within 40 feet after a speed of 20 m. p. h.; traveled successfully over a strip of railroad ties and ran down flag markers placed in consecutively difficult positions. Also the tank was driven several times over a specially prepared mound of earth approximately 40 ft. high at the center and having an incline of approximately 50 degrees.

The Baldwin M-3 tank weighs 29 tons and is powered by a 400-hp. radial Wright Cyclone engine. It carries a crew of seven, and a battery of guns including a 75-mm. semi-automatic, a 37-mm. semi-automatic and four 30-caliber machine guns. The tank was turned out at the plant three-quarters of a year ahead of schedule. It is expected that others will follow soon.

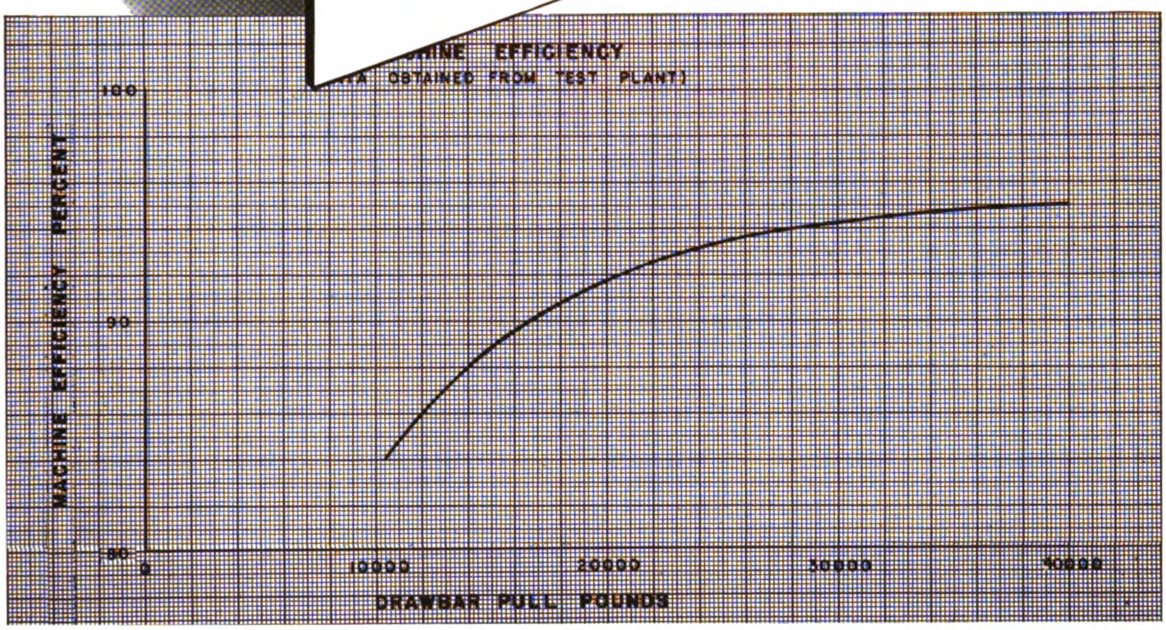
Brief addresses were delivered at the ceremony by Mr. Winterrowd, C. E. Brinley, president of Baldwin; Major Houseman; Under-Secretary of War, R. P. Patterson; Colonel W. W. Warner, chief of Artillery Division, Ordnance Department and William L. Batt, deputy director, Office of Production Management.

The Baldwin Locomotive Works turned out its first medium M-3 fighting tank on April 23

(Turn to next left-hand page)

Machine Efficiency

FRANKLIN SYSTEM OF STEAM DISTRIBUTION



MACHINE EFFICIENCY (DATA OBTAINED FROM TEST PLANT)

The inherent advantages of the Franklin System of Steam Distribution over a conventional valve gear and piston type valve, permit a marked improvement in the machine efficiency of the locomotive. Outstanding features that contribute towards this are:

1. REDUCED FRICTION

(a) The short intermittent lift of the poppet valves, as contrasted with the travel of the piston valves, with their rings, drastically reduces the power required for valve operation.

(b) By driving direct from the crosshead and eliminating the conventional outside cranks and rods necessary in a piston valve arrangement, there is a further reduction in the power necessary to actuate the steam distribution system — at 500 r.p.m. the poppet valves and their driving mechanism require only 3.30 horsepower.

2. BETTER LUBRICATION

Piston valves require lubrication over the entire sliding surface. Poppet valves require lubrication on their valve stems only, which are not in direct contact with the steam. The mechanisms actuating the poppet valves (valve gear box and cam box) are fitted with anti-friction bearings and operate in a bath of oil.

3. LIGHTER IN WEIGHT

A twelve inch piston valve weighs approximately 132 lb. The weight of the multiple poppet valves to be moved at one time is approximately 13 lb.

FRANKLIN RAILWAY SUPPLY COMPANY, INC. NEW YORK CHICAGO MONTREAL

Equipment Depreciation Rates

EQUIPMENT depreciation rates for six railroads, including the New York Central and the Norfolk & Western, have been prescribed by the Interstate Commerce Commission in a new series of sub-orders and modification of previous sub-orders in No. 15100, Depreciation Charges of Steam Railroad Companies.

The composite percentage for the N. Y. C. is 3.22 per cent, that for the N. & W., 3.62 per cent. Included in the prescribed rates for the N. Y. C. are those applicable to equipment leased from the Peoria & Eastern; another of the six sub-orders vacates a previous one which had prescribed rates for P. & E. equipment.

12,200 Air-Conditioned Cars

CLASS I railroads and the Pullman Company had 12,200 air-conditioned passenger cars in operation on January 1, according to the Association of American Railroads. This was an increase of 485 compared with the number of air-conditioned passenger cars on January 1, 1940.

Of the total number of such cars, Class I roads on January 1 had 6,961, an increase of 365 compared with the same date last year. The Pullman Company had 5,239 air-conditioned passenger cars in operation, or an increase of 120 compared with January 1, 1940.

Car Builders Complain of Steel Shortages

FREIGHT car builders, through the American Railway Car Institute, are filing complaints of postponed schedules of steel deliveries which are causing shutdowns of their erection tracks. The attention of the Office of Production Management at Washington was drawn to the seriousness of the steel situation about a month ago by both the railroads and builders. Preference delivery of steel was requested to insure continued immediate production on the large number of freight cars urgently needed to handle the increasing volume of defense production. No action has been taken and the situation has since become even more acute.

Plant shutdowns are many. One of the leading plants reports an actual forced shutdown of its erection track for as much as 60 days, or an estimated loss of productive capacity of about 1,000 cars for this particular plant. Steel deliveries have been postponed two and three months—with several plants, in some instances, unable to secure any definite delivery promise. Several steel mills are said to be refusing further orders.

Equally serious—with the enforced delay in freight car deliveries—is the loss of labor. Apprehension is felt that with the shutdown of plants skilled labor will disperse not to be regained when steel becomes available. The opinion prevails that if the large volume of cars now awaiting production and the larger volume of orders expected for 1942 and 1943 are to be delivered to the railroads as required, some provision making steel available to the builders is immediately necessary.

Eastman Says Government Should Buy the Cars

CHAIRMAN Joseph B. Eastman of the Interstate Commerce Commission feels that the cost of any excess transportation demands upon the railroads in anticipation of national defense needs over and above those normally needed by the country should be borne by the federal government. This view was made known in an address delivered by the I. C. C. chairman before the National Association of Mutual Savings Banks at Philadelphia, Pa., on May 7.

Mr. Eastman feels that the country's transportation system can carry the burdens which will be placed upon it, but he also is aware that there are possible dangers in the transportation situation. The chief danger lies, he thinks, in the things that cannot be or are not foreseen and the failure to plan and be ready for all possible contingencies. "Have the railroads," he asked, "and the other carriers been told clearly and definitely by those in charge of defense production what they will be certainly called upon to do if that program is stepped up to the utmost possible extent?

If the railroads and other carriers have this information, Mr. Eastman can see two particular dangers. One lies in the fact that the railroads and other carriers are private enterprises and it is the duty of the managements to safeguard the interests of the owners. As a result, the tendency will be, he believes, in such circumstances to be conservative in assuming financial obligations which will be permanent, in order to meet the defense needs which, it is hoped, will be temporary.

The other danger, in Mr. Eastman's opinion, is that the transportation problem will be dealt with too much as though it were a railroad problem exclusively.

A. A. R. Approves Freight Car-Buying Program

A PROGRAM calling for a net increase of 120,000 cars for the anticipated traffic of 1942 (43,680,000 carloads) and a further addition of 150,000 cars for the traffic of 1943 (estimated at 48,048,000 carloads) was adopted by member roads of the Association of American Railroads at its spring meeting at Chicago on May 12. This program is in addition to the one adopted a year ago, which called for the acquisition of 100,000 new cars for handling the 1941 traffic. According to a statement issued by the Association, the railroads will have 1,617,000 serviceable cars when the peak load of 1941 occurs in October. Of these, 168,000 will be new and 27,000 will be cars that have been rebuilt since the war broke out. This will be 156,000 more serviceable cars than they had when they handled the peak business of October, 1939. In addition, they will have 1,000 new locomotives, including 375 steam and 625 electric and Diesel, in service in October.

Discussion of the car-building capacity of plants indicated that car builders have a productive capacity of about 150,000 cars annually, while that of the railroads' own shops is about 60,000 cars a year. It was the consensus of the meeting that priorities will not have to be established in order to provide the commercial freight car builders, as well as railroad shops, with the steel and other materials needed for the new equipment unless the Office of Production Management and the defense commission are forced to establish priorities generally. Ralph Budd, president of the Chicago, Burlington & Quincy, and transportation commissioner of the Advisory Commission to the Council of National Defense, cautioned the railroads however, not to make more inroads upon the nation's steel supply than is necessary to carry out their equipment program.

The adoption of this program followed a survey of equipment needs which the directors of the A. A. R., at their meeting in Washington on April 25, directed the Car Service Division to make.

At a meeting on May 1, in connection with equipment to handle the current year's business President Pelley presented to the Priorities Division, Office of Production Management, a statement showing that railroad requirements for steel during the remainder of 1941 will total 4,914,556 tons. That figure includes requirements for rail, track materials, etc., as well as equipment, and 1,497,514 tons for the car builders and 103,622 tons for the locomotive builders.

Another subject discussed at the May 12 meeting of the Association was the possibility that the federal government may transfer many of the vessels now operating in intercoastal service and thus cause the diversion to the railroads of intercoastal traffic now moving via the Panama canal. As much as 40 per cent of the intercoastal tonnage, it was established, would move by rail. This would be equivalent to approximately 450 cars a day and in peak periods would amount to as much as 700 cars a day.

The meeting also considered the movement of grain from the southwest and approved an order, to be issued by the Car Service Division, directing eastern lines to return all western lines' box cars empty at once and calling upon western lines to route eastern lines box cars to owners, loaded, immediately.

Meanwhile the American Railway Car Institute has informed the Association of American Railroads that, if the car builders can succeed in increasing man-power and securing the necessary materials, they can produce up to 35,000 cars during the period October 1 to December 1, 1941, instead of 22,500 as had been previously estimated provided orders are placed immediately for this equipment and in lots of not less than 1,000 cars of each type. (It is estimated that the car builders are booked to capacity for delivery prior to the first of October.

Further, with this backlog, and running on an increasing schedule of production, a canvass of the industry indicates, if orders are placed with individual car building plants in lots of not less than 5,000 of each particular type of car required, that an additional 160,000 cars can be produced between January 1 and October 1, 1942. It is reported that deliveries of this number of cars, however, can be achieved only if orders and details are settled by July 1, 1941, and if they are cars of standard construction.

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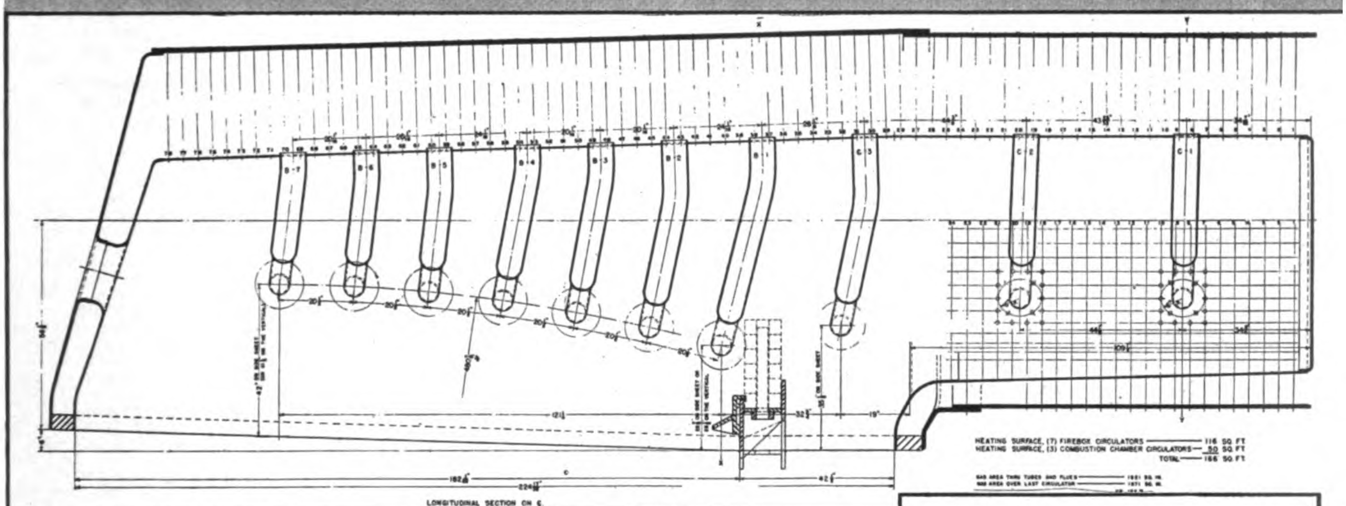
BETTER COMBUSTION

for modern freight locomotives through the application of

SECURITY CIRCULATORS



The problem of supporting brick arches of unusual length, which is the result of the demand for increased boiler horsepower, has been effectively solved by the Security Circulator, a development of the American Arch Company.

In addition to achieving the original object of improved support many other benefits have accrued. The reduction of honeycombing and cinder cutting lessens the maintenance of the boiler. The Security Circulator itself is extremely low in maintenance costs.

On the Security Circulators that have been installed during the last six years, performance has been thoroughly proved by over 10,000,000 locomotive miles of service.

Improved Arch Support for the largest fireboxes

★

Adapted to any type of locomotive

★

Reduced honeycombing, flue plugging and cinder cutting

★

Improved circulation in side water legs

AMERICAN ARCH CO., INC.

NEW YORK • CHICAGO **SECURITY CIRCULATOR DIVISION**

Southern Shopmen Vote for Six-Day Week

Some 7,500 shopmen of the Southern, during the week of April 14, voted to cancel the five-day week clause in their contract, thus extending the basic work week from 40 to 48 hours. Cancellation in this manner is provided for in the contract. The management agreed to the cancellation and notified employees that the six-day week would be restored, effective May 1.

SKF President Gets Gantt Medal

William L. Batt, president of SKF Industries, Inc., and deputy director, Production division, Office of Production Management, was awarded the 1940 Gantt Memorial Gold Medal at a dinner on April 22 in conjunction with a two-day management conference on national defense of the American Society of Mechanical Engineers in Philadelphia, Pa. The Gantt Gold Medal was established in 1929 and is awarded annually by a board made up of representatives of the A. S. M. E. and the Institute of Management. Mr. Batt was cited "for distinguished and liberal-minded leadership in the art, science and philosophy of industrial management in both private and public affairs."

Mr. Batt, in addition to his duties cited above, is chairman of the Business Advisory Council of the United States Department of Commerce; chairman of the division of engineering and industrial research of the National Research Council and chairman of the board of the American Management Association. He was president of the A. S. M. E. in 1936 and in 1938 acted as chairman of the executive committee of the Seventh International Management Conference in Washington, D. C.

Equipment Purchasing and Modernization Programs

The Alabama, Tennessee & Northern.—Authorization has been granted the Alabama, Tennessee & Northern by the district court to purchase a 300-hp. Diesel-electric locomotive. It has also been authorized to purchase two used locomotives from the Gulf, Mobile & Ohio.

Baltimore & Ohio.—The B. & O. has asked the Interstate Commerce Commission for authority to assume liability for $5,880,000 of equipment trust certificates, maturing in 10 equal annual installments of $588,000 on June 1 in each of the years from 1942 to 1951, inclusive. The proceeds will be used as part of the purchase price of new equipment costing a total of $7,400,510 and consisting of 150 50-ton, 50 ft. 6 in. steel box cars; 50 50-ton, 50 ft. 6 in. steel box cars with end door; 50 50-ton, 50 ft. 6 in. steel automobile box cars; 150 70-ton, 26 ft. 3⅛ in. steel hopper cars; 1,000 50-ton, 33 ft. steel hopper cars; 500 70-ton, 52 ft. 6 in. steel gondola cars; and 500 70-ton, 52 ft. 6 in. steel gondola cars.

The Carnegie-Illinois Steel Corporation.—The Carnegie-Illinois Steel Corp. is reported to be inquiring for 30 ingot cars of 125 tons' capacity.

Orders and Inquiries for New Equipment Placed Since the Closing of the May Issue

Locomotive Orders

Road	No. of Locos.	Type of Loco.	Builder
Alabama, Tennessee & Northern	1	45-ton Diesel-elec.	General Electric Co.
Aluminum Co. of America	1[1]	650-hp. Diesel-elec.	Whitcomb Loco. Co.
Arcade & Attica	1	44-ton Diesel-elec.	General Electric Co.
Atlantic Steel Co.	1[2]	320-hp. Diesel-elec.	Whitcomb Loco. Co.
Brooklyn Navy Yard	1[2]	300-hp. Diesel-elec.	Whitcomb Loco. Co.
Canadian Pacific	20	4-6-2	Montreal Loco. Wks.
Canton	1	600-hp. Diesel-elec.	Electro-Motive Corp.
Chicago & North Western	1[1]	190-hp. Diesel-hydraulic	Whitcomb Loco. Co.
Chicago, Milwaukee, St. Paul & Pacific	6	380-hp. Diesel-elec.	Whitcomb Loco. Co.
	2	360-hp. Diesel-elec.	General Elec. Co.
Day & Zimmerman	4	380-hp. Diesel-elec.	Whitcomb Loco. Co.
Denver & Rio Grande Western	1	380-hp. Diesel-elec.	General Electric Co.
	3	5,400-hp. Diesel-elec.	Electro-Motive Corp.
	4	1,000-hp. Diesel-elec.	American Loco. Co.
	9	600-hp. Diesel-elec.	Baldwin Loco. Wks.
East Erie Commercial	1	65-ton Diesel-elec.	General Electric Co.
Electro-Metallurgical	2[1]	500-hp. Diesel-elec.	Whitcomb Loco. Co.
Erie City Iron Works	1[2]	190-hp. Gas-mech.	Whitcomb Loco. Co.
Houston Shipbuilding Corp.	3	30-ton Diesel-elec.	Whitcomb Loco. Co.
Maxon Construction Co.	1[2]	300-hp. Diesel-elec.	Whitcomb Loco. Co.
Midvale Co.	2[2]	320-hp. Diesel-elec.	Whitcomb Loco. Co.
	1[1]	193-hp. Diesel-elec.	
Minneapolis, St. Paul & Sault Ste Marie	1	380-hp. Diesel-elec.	General Electric Co.
Missouri & Illinois Bridge & Belt	1	380-hp. Diesel-elec.	General Electric Co.
Newfoundland	1[4]	2-8-2	Montreal Loco. Wks.
New York, New Haven & Hartford	5[5]	4,000-hp. Diesel-elec.	American Loco. Co.
	6	44-ton Diesel-elec.	General Elec. Co.
Pennsylvania Forge Co.	1[1]	190-hp. Gas-mech.	Whitcomb Loco. Co.
Philadelphia, Bethlehem & New England	2	600-hp. Diesel-elec.	Electro-Motive Corp.
Robervale & Saguenay	1[2]	386-hp. Diesel-elec.	Whitcomb Loco. Co.
Reading	2[6]	1,000-hp. Diesel-elec.	Electro-Motive Corp.
	2[6]	600-hp. Diesel-elec.	
	2[6]	600-hp. Diesel-elec.	American Loco. Co.
Roebling's, John A. Sons Co.	1[1]	190-hp. Diesel-hydraulic	Whitcomb Loco. Co.
Scullin Steel Co.	1[2]	320-hp. Diesel-elec.	Whitcomb Loco. Co.
South Buffalo	3	1,000-hp. Diesel-elec.	American Loco. Co.
Steelton & Highspire	2	70-ton Diesel-elec.	General Electric Co.
Stone & Webster	2[1]	500-hp. Diesel-elec.	Whitcomb Loco. Co.
Texas Pacific-Missouri Pacific-Terminal R. R. of New Orleans	1	660-hp. Diesel-elec.	American Loco. Co.
Union Carbide	1[3]	300-hp. Diesel-elec.	Whitcomb Loco. Co.
United States Navy Dept.	1	50-ton Diesel-elec.	Whitcomb Loco. Co.
	1	50-ton Diesel-elec.	Atlas Car & Mfg. Co.
	2[7]	50-ton Diesel-elec.	H. K. Porter Co.
U. S. War Dept.	5[2]	190-hp. Gas-mech.	Whitcomb Loco. Co.
	5	2-6-2	American Loco. Co.
	8	45-ton Diesel-elec.	General Electric Co.
Vanadium Corp. of America	1[2]	210-hp. Diesel-mech.	Whitcomb Loco. Co.
Wabash	1	660-hp. Diesel-elec.	American Loco. Co.
Wabash Portland Cement Co.	1[2]	190-hp. Diesel-mech.	Whitcomb Loco. Co.
Westinghouse Elec. & Mfg. Co.	1[1]	320-hp. Diesel-elec.	Whitcomb Loco. Co.

Locomotive Inquiries

Canadian Pacific[5]	15	4-6-2	
New York Central	15	4-8-2	....
	15	350 and 600-hp. Diesel electric	....

Freight-Car Orders

Road	No. of Cars	Type of Car	Builder
American Gas & Electric Co.	6	100-ton well	American Car & Fdry.
American Locomotive Co.	2	100-ton flat	American Car & Fdry.
American Refrig. Transit Co.	150	Refrigerator	Co. shops
Ann Arbor	25	55-ton hopper	Co. shops
Atlantic Coast Line	800	50-ton box	American Car & Fdry.
	800	50-ton box	Pullman-Standard
	700	50-ton auto	American Car & Fdry.
	300	50-ton furniture	Mt. Vernon
	200	50-ton h.s. gondalos	Bethlehem
	100	70-ton covered hopper	Bethlehem
Baltimore & Ohio	27	70-ton gondola	Bethlehem Steel
	100	Cabooses	Co. shops
Boston & Maine	4	90-ton depressed center	Co. shops
Canadian Pacific	250	50-ton hopper	Magor Car Corp.
Chicago & North Western	500	50-ton box	American Car & Fdry.
	500	50-ton box	Pullman-Standard
Chicago, Rock Island & Pacific	1,000	50-ton box	Pressed Steel Car
Delaware & Hudson	300	50-ton hopper	
	200	50-ton gondola	American Car & Fdry.
	50	70-ton covered hopper	
Detroit, Toledo & Ironton	50	Hopper	Greenville Steel Car Co.
Denver & Reo Grande Western	500	40-ton box	Pressed Steel Car Co.
	3	Flat	Co. shops
Erie	70	Caboose	Co. shops
Kansas City Southern	50	50-ton auto	
	20[9]	50-ton box	Pullman-Standard
	75[9]	70-ton hopper	
Lehigh & New England	15[10]	70-ton hopper-bottom	American Car & Fdry.
Minneapolis, St. Paul & Sault Ste. Marie	250	50-ton box	Pullman-Standard
Missouri Pacific	100	50-ton auto parts	American Car & Fdry.
New York Central	10[11]	Well	
	14	100-ton transformer	Despatch Shops, Inc.
	3,000	55-ton box	
New York, Chicago & St. Louis	18	70-ton covered hopper	American Car & Fdry.
Norfolk & Western	1,000	50-ton box	Ralston Steel Car
	200	50-ton box	Greenville Steel Car
Pere Marquette	25	70-ton covered hopper	American Car & Fdry.
Sanderson & Porter Co.	50	Box	General American
Southern	1,900	50-ton box	[12]
	500	70-ton flat	Mt. Vernon Car
	100	70-ton M. J. gondola	
	1,500	50-ton box[12]	Pullman-Standard

Southern Pacific	4	200-ton flat	Mt. Vernon Car
Union Pacific	100	Caboose	Mt. Vernon Car
	2,000	50-ton box	Company shops
	250	Automobile	
United States Government	50	6,000-gal. tank	American Car & Fdry.
	50	30-ton flat	
United States Navy	15	50-ton flat	American Car & Fdry.
Utah Copper Co.	75	100-ton ore	Pressed Steel
Wisconsin Central	150	50-ton box	Pullman-Standard

FREIGHT-CAR INQUIRIES

Atchison, Topeka & Santa Fe	100	Caboose	....
	2,000	Freight	....
Boston & Maine	600	40-ton box	....
	500	50-ton gondola	....
	500	50-ton twin hopper	....
Delaware & Hudson	300	50-ton hopper	....
	200	50-ton gondola	....
	50	70-ton covered hopper	....
Erie	5	90-ton flat	....
Norfolk & Western	25	70-ton gondola	....
Missouri Pacific	800	50-ton box	....
	200	50-ton auto	....
	50	70-ton covered cement	....
Southern Pacific	2,500	Box	....
Western Maryland	500	Box	....
	300-500	Hopper	....
	200	Drop-end gondola	....
	25	Flat	....
Western Pacific	350	50-ton box	....
	350	50-ton flat	....

PASSENGER-CAR ORDERS

Road	No. of Cars	Type of Car	Builder
Chicago, Rock Island & Pacific	7	Chair	Edw. G. Budd
	2	Dining	
Denver & Rio Grande Western	4	Train Cars[13]	Edw. G. Budd
Illinois Central	2	Dining	Pullman-Standard
Southern	25	Bagg.-exp.	St. Louis Car

PASSENGER-CAR INQUIRIES

Delaware, Lackawanna & Western[8]	10	Bagg.-exp.	....

[1] Ordered in February; not previously reported in the *Railway Mechanical Engineer.*
[2] Ordered in January; not previously reported in the *Railway Mechanical Engineer.*
[3] Ordered in March; not previously reported in the *Railway Mechanical Engineer.*
[4] In addition to one reported in May issue.
[5] Double-end road locomotives for handling fast passenger and freight trains.
[6] Authorization for the purchase of ten Diesel-electric locomotives was reported in the May issue. The Baldwin Locomotive Works is expected to receive the order for the remaining four 600-hp. units.
[7] At a total cost of $50,118.
[8] Reported to be considering the purchase.
[9] For the Louisiana & Arkansas.
[10] With hatchway roof, for bulk cement.
[11] Order unconfirmed.
[12] Fifty of the box cars will have end doors and 50 end doors and auto loaders. Estimated cost of order for 2,500 cars placed with Mt. Vernon $7,500,000; 1,500 cars placed with Pullman-Standard $4,200,000.
[13] Streamlined passenger-train cars with a power plant in each car. The cars to comprise two 2-car passenger trains.

Chesapeake & Ohio.—The C. & O. has asked the Interstate Commerce Commission for authority to assume liability for $5,100,000 of serial equipment trust certificates to be sold at competitive bidding with an interest rate not to exceed 2½ per cent. The proceeds will be used as part payment of the purchase price of new equipment costing a total of $6,440,993 and consisting of 1,000 50-ton, 40-ft., 6 in., all-steel box cars; 1,000 50-ton, all-steel hopper cars; 50 50-ton, 50-ft., all-steel flat cars; 25 70-ton, 56-ft., all-steel flat cars; 10 125-ton, 56-ft., all-steel flat cars; six 125-ton 51-ft., 6¾ in., all-steel flat cars; four 125-ton 61-ft., 4¾ in., all-steel flat cars and 20 all-steel passenger coaches. The certificates have been dated May 1, 1941, and will mature in 10 equal annual installments on May 1 in each of the years from 1942 to 1951, inclusive.

Chicago & North Western.—The C. & N. W. has asked the Interstate Commerce Commission for authority to assume liability for $2,325,000 of equipment trust certificates, maturing in annual installments beginning July 1, 1942 and ending July 1, 1951, inclusive. The proceeds will be used as part of the purchase price of new equipment costing $3,100,000 and consisting of 1,000 50-ton, 40-ft., 6 in., all-steel box cars.

The Chicago, St. Paul, Minneapolis & Omaha.—The Milwaukee has applied to the Interstate Commerce Commission for approval of a sale to the Reconstruction Finance Corporation of $1,680,000 of 2½ per cent equipment trust certificates at par and accrued dividends. The certificates, dated July 1, 1941, would mature in 15 equal annual installments on July 1 of each year from 1942 to 1956. The application stated that the best bid received from private banking interests would have put the certificates on a 2⅞ per cent basis which the applicant regarded as unsatisfactory. The transaction would finance the acquisition from the American Car and Foundry Company of 700 all-steel box cars of 50 tons capacity.

The Delaware, Lackawanna & Western.—The D. L. & W. is reported to be contemplating the acquisition of 1,500 freight cars, comprising 1,000 box and 500 gondola cars.

Erie.—The Erie has asked the Interstate Commerce Commission for authority to assume liability for either $4,000,000 or $4,500,000 of equipment trust certificates, maturing in 10 equal annual installments beginning on May 15, 1942 and ending May 15, 1951. The proceeds will be used as part payment of the purchase price of new equipment costing a total of $5,000,000 and consisting of 800 50-ton box cars, 100 50-ton automobile cars, 100 50-ton furniture cars, 50 70-ton flat cars, 250 drop-end, mill type gondola cars, 50 covered hopper cars, 250 50-ton center dump hopper cars, five heavy-duty flat cars, and five express-baggage cars.

Great Northern.—Directors of the Great Northern on May 9, approved a program calling for the purchase of 17 Diesel-electric switching locomotives.

The Lehigh & New England.—The L. & N. E. is reported to be inquiring for from 200 to 500 center dump hopper cars of 50 tons' capacity.

The Lehigh Valley.—The L. V. is expected to enter the market for 500 65-ft. gondola cars, 400 40-ft. 6-in. box cars of 50 tons' capacity, 100 50-ft. 6-in. auto box cars of 50 tons' capacity and 10 special flat cars.

Louisville & Nashville.—The L. & N. has asked the Interstate Commerce Commission for authority to assume liability for $4,970,000 of equipment trust certificates, maturing in 10 equal annual installments of $497,000 on June 15 in each of the years from 1942 to 1951, inclusive. The proceeds will be used as part of the purchase price of new equipment costing a total of $5,522,223 and consisting of 1,000 50-ton, all-steel hopper cars, 1,000 50-ton, steel-sheathed, wood-lined box cars, and 100 50-ton, all-steel, wood-lined, double-door box cars.

Missouri Pacific.—The M. P. has asked the Interstate Commerce Commission for authority to assume liability for $2,895,000 of equipment trust certificates, maturing in 15 equal annual installments of $193,000 on June 16, in each of the years from 1942 to 1956, inclusive. The proceeds will be used as part payment of the purchase price of new equipment costing $3,872,936 and consisting of two 1,000-hp. Diesel-electric switchers, two 600-hp. Diesel-electric switchers, seven 44-ton Diesel-electric switchers, one double end control, rail motor car, 1,200 55-ton, all-steel hopper cars, and two 125-ton, depressed center, flat cars.

Montour.—The Montour has asked the Interstate Commerce Commission for authority to assume liability for $500,000 of equipment trust certificates, bearing interest at not more than 2½ per cent and maturing in five equal annual installments on June 16 in each of the years from 1942 to 1946, inclusive. The proceeds will be used as a part of the purchase price of new equipment costing a total of $702,381 and consisting of 300 all-steel, 50-ton hopper cars.

The Western Pacific.—The Western Pacific will ask the district court for authority to purchase three 5,400-hp. Diesel-electric locomotives.

Wheeling & Lake Erie.—The W. & L. E. has asked the Interstate Commerce Commission for authority to assume liability for $800,000 of equipment trust certificates, maturing in equal annual installments beginning May 15, 1942 and ending May 15, 1951. The proceeds will be used as part of the purchase price of new equipment costing a total of $1,116,500 and consisting of 500 all-steel, self-clearing, 60-ton hopper cars. The company informs the commission that no bid in excess of two per cent of par will be accepted.

(Turn to second left-hand page)

Can Pull-Pull-Pull

LIKE the proverbial bulldog which pulls and pulls and never quits — the EMC 5400 hp. Diesel, the world's most powerful freight locomotive, can outpull and outperform any steam locomotive thus far built. This "Bulldog of the Rails" has greatest tonnage moving capacity, can operate continuously over long runs, and with its dynamic braking feature can handle trains down heavy grades faster, safer and with minimum brake applications — and at a greatly reduced cost of operation.

On a recent test trip between Argentine, Kansas, and Los Angeles, with no attempt for speed or tonnage records, Santa Fe 5400 hp. Diesel freight locomotive No. 100 with a maximum of 68 cars (3,150 tons) made the 1761.8 miles in 54 hrs. 35½ mins.

ELECTRO-MOTIVE

SUBSIDIARY OF GENERAL MOTORS

Bulldog OF THE RAILS

GM
GENERAL MOTORS
DIESEL POWER

Pull-Pull-Pull-Pull

running time—an average speed of 32.3 m.p.h. The locomotive demonstrated ample capacity for handling much heavier trains and at subsantially higher speeds.

One of the most outstanding features of the entire performance was the ability of this Diesel locomotive to make the entire trip with only four stops required for fuel and water; whereas a total of seven steam locomotives would generally be required to handle the same train on the same run with 12 stops required for fuel and water and 16 additional stops for water only.

BIGGER OPERATING ECONOMIES FOLLOW DIESEL EXPANSION

CORPORATION

GRANGE, ILLINOIS, U. S. A.

Supply Trade Notes

A. Van Hassel, president of the Magor Car Corporation, has been elected a director of the Ralston Steel Car Company.

◆

Paxton-Mitchell Company. — *P. A. Pounds* has been appointed vice-president and assistant general manager; *E. B. Christensen,* secretary and treasurer and *David J. Miller,* sales manager of the Paxton-Mitchell Company, Omaha, Neb.

◆

O. C. Duryea Corporation.—*John A. Dillon* has been elected vice-president of the O. C. Duryea Corporation, with headquarters at New York. Mr. Dillon was formerly vice-president in charge of Eastern sales of the Pittsburgh Screw & Bolt Corporation. *W. M. Ryan,* representative of the corporation at Chicago, has been elected vice-president, with headquarters at Chicago. The general office of the corporation in New York has been moved from 30 East Forty-second Street, to 30 Rockefeller Plaza.

◆

R. J. Van Meter has been elected vice-president of The Superheater Company, with headquarters at Chicago. Mr. Van Meter received his education in the public schools of Sturgis, Mich., and in special courses in business and engineering. He started his business career in 1902 on the Grand Rapids and Indiana as a locomotive

R. J. Van Meter

fireman. Subsequently he served as traveling engineer and special representative in the transportation department with the Pennsylvania; shop machinist and locomotive fireman with the New York Central; in locomotive service on the Atchison, Topeka & Santa Fe and the Colorado & Southern, and millwright and power plant operator in Denver, Colo., and Ft. Wayne, Ind. He became associated with The Superheater Company on May 1, 1917, and since that time has served as service engineer, special representative, assistant service manager, assistant to vice-president, and manager of western sales and service.

Joseph F. Clary has been appointed head of the railway sales contract department of the Edward G. Budd Manufacturing Company, succeeding the late William T. Bennison, whose obituary appeared in

Joseph F. Clary

the April issue. Mr. Clary joined the Budd Company in 1933, and, as project engineer in the rail-car division, has worked in the design or engineering of all the stainless-steel streamliners built by the company. He is a graduate of the Massachusetts Institute of Technology, 1929, and was previously associated with the Firestone Tire & Rubber Co. His headquarters will be at the Budd, Philadelphia, Pa., plant.

◆

Samuel S. Bruce, Jr., has been appointed sales representative of the Duff-Norton Manufacturing Company, with headquarters at the company's general offices in Pittsburgh, Pa.

◆

The Ajax Hand Brake Company, Chicago, has appointed the Portable Plating and Equipment Company, Chicago, its exclusive sales agent for the Ajax hand brake within the United States, effective April 1.

◆

George H. Goodell, who for many years has been northwestern sales agent of the National Lock Washer Company, Spring Washer division, has been appointed to also represent this company in the sale of national de luxe windows and car equipment.

◆

Inland Steel Company. — *Wilfred Sykes* has been elected president of the Inland Steel Company, Chicago, succeeding *Philip D. Block,* who has been elected chairman of the executive committee. *L. E. Block,* who served as chairman of the board for many years prior to 1940, has been elected chairman of the finance committee. *James H. Walsh,* works manager of Inland's Indiana Harbor works has been elected vice-president in charge of steel works.

Charles T. Siebert, Jr., formerly assistant treasurer and credit manager, has been appointed assistant to the vice-president in charge of sales of the Carnegie-Illinois Steel Corporation, Pittsburgh, Pa.

◆

John H. McCartney, formerly New York representative, has been appointed manager of sales of the Brake Equipment & Supply Co., of Chicago. Mr. McCartney will make his headquarters at the company's general office in Chicago.

◆

The Independent Pneumatic Tool Company, Chicago, will move its Philadelphia, Pa., branch into its newly constructed buildings at Seventeenth and Fairmount avenues. The company has also recently completed a $500,000 plant in Los Angeles, Calif.

◆

Forrest G. Sharpe, formerly assistant to the sales manager, has been appointed Philadelphia, Pa., sales engineer of the Pangborn Corporation, Hagerstown, Md.

◆

John H. Collier, vice-president of the Crane Company, Chicago, has been elected president to succeed Charles B. Nolte, deceased.

◆

DeVilbiss Company.—*Howard P. De Vilbiss* and *Roy A. Guyer* have been elected vice-presidents of the DeVilbiss Company, Toledo, Ohio. Mr. DeVilbiss, son of the founder, has been active in the company since his father's death in 1928, and Mr. Guyer has been sales manager of the spray-painting division.

Obituary

Charles B. Nolte, president of the Crane Company, Chicago, died suddenly on April 29, following a heart attack.

◆

Alex T. Anderson, district manager, midwestern territory of the Duff-Norton Manufacturing Company, with headquarters at Chicago, died on April 29.

◆

O. C. Duryea, president of the O. C. Duryea Corporation, New York, died in St. Lukes Hospital, Chicago, on April 27. Mr. Duryea had been ill for three months. He was born in Wyoming, Ill., April 25, 1880, and began his business career in the employ of his brothers manufacturing early automobiles. Before he was 21, however, he had received a number of patents on his own inventions. These were followed by many others. One of the most notable of his inventions was the Duryea railway cushion underframe for which he was awarded the George R. Henderson gold medal by the Franklin Institute of Philadelphia in 1933.

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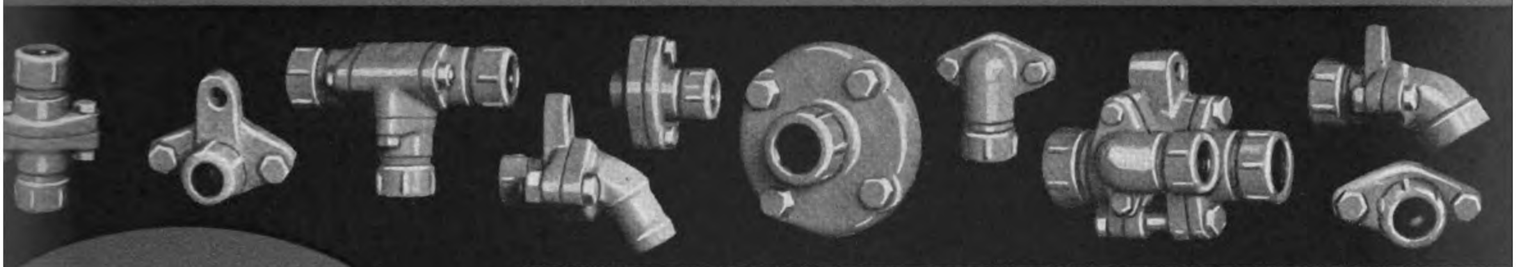

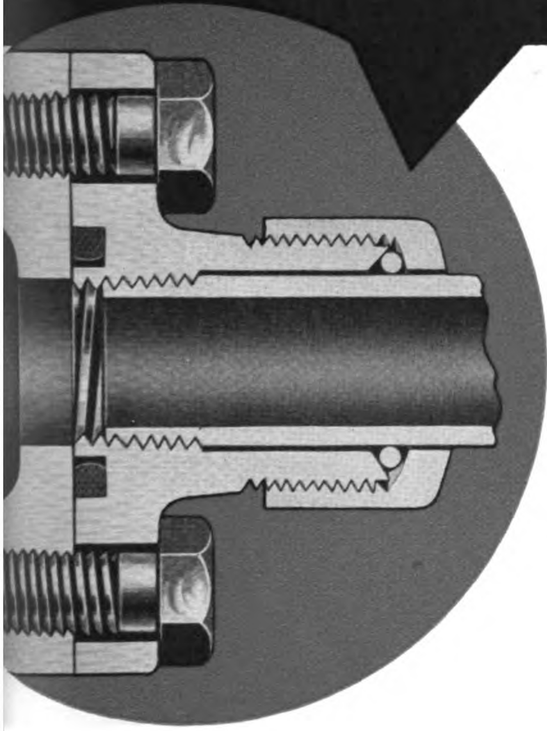

Personal Mention

General

H. J. Stein has been appointed engineer of tests of the Atlantic Coast Line, with headquarters at Wilmington, N. C.

R. C. Winningham has been appointed general mechanical inspector of the South-Central and Northwestern districts of the Union Pacific, with headquarters at Los Angeles, Calif.

Dean F. Willey, whose promotion to general mechanical superintendent of the New York, New Haven & Hartford at New Haven, Conn., was reported in the May issue of the *Railway Mechanical Engineer* was born in Manchester, N. H., and was graduated from Massachusetts Institute of Technology in 1920. Mr. Willey entered railroad service with the New Haven in June, 1920, as assistant engineer, department of tests, and on April 1, 1923, was appointed general material supervisor. In October of the same year he became mechanical inspector and in November, 1923 was appointed foreman mechanical inspector at Boston, Mass., being promoted to acting general foreman in July, 1924. Mr. Willey became general foreman on November 1, 1924, and on September 16, 1925, was appointed assistant to superintendent of shops at Readville, Mass. He returned to New Haven as special mechanical assistant on May 16, 1930, and was promoted to mechanical superintendent on January 1, 1937.

Dean F. Willey

Master Mechanics and Road Foremen

J. W. McAuley, assistant suprintendent and master mechanic of the Canadian National at Prince George, B. C., has resigned.

C. J. Sears, road foreman of engines on the Chicago Terminal and Logansport divisions of the Pennsylvania, has been appointed road foreman of engines of the Chicago Terminal Division, with headquarters at Chicago.

L. W. Keyser has been appointed assistant road foreman of engines on the Maryland division of the Pennsylvania.

G. R. Steeves, locomotive foreman on the Canadian National at Jasper, Alta., has been promoted to master mechanic at Prince George, B. C.

G. S. Webb, general electrician for the Eastern region of the Pennsylvania, has been appointed assistant master mechanic at Columbus, Ohio.

W. M. Martin, engineer, steam locomotive design on the Union Pacific at Omaha, Neb., has been appointed assistant master mechanic at Council Bluffs, Iowa.

M. M. Quinn, assistant road foreman of engines on the Maryland division of the Pennsylvania, has been transferred to the position of assistant road foreman of engines on the Philadelphia division.

J. L. Brossard, assistant division master mechanic of the Chicago terminals of the Chicago, Milwaukee, St. Paul & Pacific, has been appointed master mechanic at Aberdeen, S. D.

W. P. Primm, assistant train master-assistant road foreman of engines on the Monongahela division of the Pennsylvania, has been appointed road foreman of engines on the Toledo division, with headquarters at Toledo, Ohio.

H. N. Rowles, road foreman of engines on the Toledo division of the Pennsylvania, has been appointed road foreman of engines on the Logansport division, with headquarters at Logansport, Ind.

Car Department

G. B. Gibson, assistant master mechanic of the Pennsylvania at Columbus, Ohio, has been promoted to general foreman of the Altoona car shop, Altoona, Pa.

Shop and Enginehouse

H. M. Sherrard, division master mechanic on the Baltimore & Ohio at Grafton, W. Va., has been appointed superintendent of shops at Glenwood, Pa.

John L. Quinn, night foreman of the Chesapeake & Ohio at Gladstone, Va., has been promoted to the position of general foreman, with headquarters at Gladstone.

William McVicker, general foreman at the Altoona, Pa., car shop of the Pennsylvania, has been promoted to the position of assistant works manager at the Altoona works.

F. O. Fernstrom, master mechanic of the Hastings and Dakota division of the Chicago, Milwaukee, St. Paul & Pacific at Aberdeen, S. D., has been appointed shop superintendent at Minneapolis, Minn., with jurisdiction also over the Twin City terminals and the Duluth division.

Purchasing and Stores

Theodore White has been appointed storekeeper on the Union Pacific at Glenns Ferry, Idaho.

V. W. Mitchell, chief clerk to the storekeeper at Aurora, Ill., has become general storekeeper of the Fort Worth & Denver City at Childress, Tex.

J. J. Jirousek, assistant storekeeper on the Chicago, Burlington & Quincy at Aurora, Ill., has been appointed division storekeeper at Hannibal, Mo.

J. W. Schwartz, division storekeeper on the Chicago, Burlington & Quincy at St. Joseph, Mo., has been promoted to assistant storekeeper at Aurora, Ill.

W. F. Myers, general storekeeper of the Fort Worth & Denver City, with headquarters at Childress, Tex., has been appointed division storekeeper at St. Joseph, Mo.

Obituary

R. K. Carr, assistant to superintendent motive power of the Norfolk & Western, with headquarters at Roanoke, Va., died on May 4 at the age of 56.

Burton P. Flory, who retired on April 1, 1937, as superintendent of motive power of the New York, Ontario & Western at Middletown, N. Y., died on April 29 at Sarasota, Fla., after a short illness, at the age of 67.

Robert Blaine Spencer, master mechanic of the Southwestern and Western divisions of the St. Louis-San Francisco, with headquarters at West Tulsa, Okla., who died on December 24, as announced in the February issue, was born on July 16, 1884, at Salem, Va. Mr. Spencer entered railway service as a messenger on the Norfolk & Western at Roanoke, Va., in 1899. He served his machinist apprenticeship from 1900-1903 at Roanoke and from 1903-1907, was enlisted in the U. S. Navy. He became a machinist on the Atlantic Coast Line at Waycross, Ga., in 1907; night enginehouse foreman at Thomasville, Ga., in 1908; enginehouse foreman at Waycross in 1909; general foreman at Thomasville in 1911, and general foreman at Savannah, Ga., in 1913. In 1918, Mr. Spencer was promoted to master. mechanic. Six months later he went to work in the shipyard of the Foundation Company, Savannah. He reentered the service of the St. Louis-San Francisco at Amory, Miss., in 1920, working successively as a machinist, foreman, and general foreman until 1922. He became enginehouse foreman in the Springfield South shops in 1923 and general foreman at West Tulsa, in March, 1923. Mr. Spencer became master mechanic of the Southwestern division in July, 1925, and later his duties were expanded to include also the Western division.

July 1941

Railway Mechanical Engineer

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RAILWAY
MECHANICAL ENGINEER

National Defense the Center of Thought at

Mechanical Division Meeting

Discussions indicate far-reaching effect of priorities on new equipment — Reports on car construction, locomotive construction, lubrication, couplers and draft gears, brakes and brake equipment, and wheels all drew forth extensive comment

THE demands on the railroads of the national defense program and the measures which the railroads can take to insure that there will be no failure on their part to supply the needed transportation were the themes of several speakers who addressed the annual meeting of the Mechanical Division, Association of American Railroads, which was held at the Hotel Jefferson, St. Louis, Mo., June 19 and 20. The same thought was also in the background of the discussion of several of the eleven reports of standing committees which were presented during the meeting.

Presiding at the meeting where Chairman W. H. Flynn, general superintendent motive power and rolling stock, New York Central, and Vice-Chairman R. G. Hen-

W. H. Flynn,
Chairman

R. G. Henley,
Vice-Chairman

V. R. Hawthorne,
Executive Vice-Chairman

D. S. Ellis

O. A. Garber

F. W. Hankins

J. Purcell

G. C. Christy

H. B. Bowen

ley, superintendent motive power, Norfolk & Western. There was a total registered attendance of about 550 members and guests, of which about half were railroad men and half representatives of railway equipment manufacturers and supply companies. The principal address was delivered by L. W. Baldwin, chief executive officer, Missouri Pacific Lines, who appealed for more complete cooperation between railway departments in meeting the demands of the present emergency. Other speakers during the meeting were C. H. Buford, vice-president, Operations and Maintenance Department, A.A.R.; W. J. Patterson, member, Interstate Commerce Commission, and Roy V. Wright, editor, *Railway Mechanical Engineer*.

Five new members of the General Committee were elected to fill vacancies. These are H. B. Bowen, chief motive power and rolling stock, Canadian Pacific; E. B. Hall, chief mechanical officer, Chicago & North Western; H. H. Urbach, mechanical assistant to executive vice-president, Chicago, Burlington & Quincy; Geo. McCormick, general superintendent motive power, Southern Pacific, and O. Jabelmann, vice-president, Research and Mechanical Standards, Union Pacific. The terms of the chairman and vice-chairman are two years, and Messrs. Flynn and Henley will continue to serve until after the next annual meeting.

L. W. Baldwin Voices Confidence in Railroads

In welcoming the members and guests of the A. A. R. Mechanical Division to St. Louis, L. W. Baldwin, chief executive officer, Missouri Pacific, referred to his pleasant association with them of many years standing and that he could, therefore, talk to them not as strangers but as men who think and work along the same lines that he does. Mr. Baldwin expressed gratification at the accomplishments of the railways in recent strenuous years and said that the railways will meet and do all that is expected of them in the present defense emergency. Railroads have learned to do work better and get better materials and more production per man hour in repair shops than a decade ago. Efficient railroading is not magic but only plain common sense. As in every other business, he said, railroad men get out of their employment just what they put in.

Referring to the impression which many people seem to have, unfortunately, that the railroads cannot handle expected traffic peaks, Mr. Baldwin said that he does not believe this and that cooperation between railroads, shippers and manufacturers will produce the desired results. He said, for example, that the loading of cars to full capacity would be equivalent to 100,000 additional cars over night. He suggested the handling of railroad material also in full cars, the movements being made with as little delay as possible enroute and at terminals. He said he does not question the need for the new car program, but much can be accomplished by increasing the speed of car movement, loading and unloading.

Mr. Baldwin stressed the importance of putting the present ownership of cars in good condition for use, especially when this can be done at relatively little expense. For example, on one road, out of an average of 30,000 cars, a total of 6,500 cars were raised from B to A class

at an expenditure of $50 or less per car. Mechanical-department officers can also help by expediting car repairs and being sure that necessary repair materials are on hand before cars are taken out of service, which will increase the car supply at least five per cent.

With reference to motive power, Mr. Baldwin said that modern steam and Diesel locomotives have made a remarkable achievement from the point of view of increased reliability and efficiency in operation and that locomotive shop maintenance practices also have been substantially improved. He urged that neither locomotives nor cars be sent out on the road in such condition that they cannot make a successful trip. He urged the development of inspection methods sufficiently careful and comprehensive to assure this accomplishment. Mr. Baldwin said that cooperation must start with the staff officers who compare their mutual problems and take steps to make sure that all employees work together in harmony so far as possible.

Railroads must do a thorough job in cooperation to promote the defense program of the United States. Mr. Baldwin suggested that every possible assistance be extended to the war industries and said that if the American railroads will cooperate in this objective, they will perform a service of which they may well be proud. He stated that in the present emergency railroads should forget competition and help other roads to supply necessary transportation. They should work together as they are now being more severely tested and more closely watched than at any time since the World war.

C. H. Buford Talks About Priorities

World conditions are changing rapidly and problems in this country are different from what we expected they would be even a few months ago. Our defense program started less than a year ago, and it cost four billion dollars in 1940. The expense is estimated at 17 billions for 1941 and at 23 billions for 1942. On top of this, we have the seven-billion-dollar lease-lend bill and about three and one-half billion dollars in British orders placed in this country. The need for transportation will increase. More transportation means more labor and material and it means a more intensive use of cars and locomotives.

Purchasing officers are now assembling information as to the amount of the various metals needed by the railroads for car and locomotive construction and maintenance. They will present this information to the Priority Division of the Office of Production Management at Washington, and will make every effort to get what you need, although they may not be able to get everything that you want. For example, it seems clear we are not going to obtain aluminum for the construction of new cars. We hope to get repair material needed for the units we now have. Other similar conditions will arise, and you will be advised promptly of the changes so you can make arrangements accordingly.

We have had difficulty in getting steel plates, shapes, and bars. Some railroad repair work has been delayed and some car construction has been shut down. This week action has been taken to solve this problem.

E. B. Hall

H. H. Urbach

G. McCormick

O. Jabelmann

A. C. Browning, Secretary

W. I. Cantley, Mechanical Engineer

Suggestions have been made that we explore the use of substitutes, and one of these is that we use wood instead of steel for the superstructure of cars. You probably know the answer before you investigate. In fact, I am sure that all of us who have been around cars for years have a fairly good idea of the answer. Regardless of how much we know or just what we think, we must make a thorough investigation, because the suggestion comes from high authority. If your study is thorough and your conclusions are sound, you will be in a better position to get the materials you need.

Under the stress of emergency, other suggestions may be made in the future. Some of these may come from people who are sincere but who know little of the service requirements or the details of your work. If any of these are referred to you, I urge that you handle them carefully and thoroughly and that you present the facts in as convincing a way as you can.

Do not let these new problems or questions disturb you and, above all, do not relax your endeavors still further to improve the standards and practices with respect to the equipment.

The Need for More Intensive Use of Equipment

I could spend hours telling you about the methods used for estimating prospective business and railroad capacity. After I had taken that much of your time, you would know as much as anyone else—and you would not have the answer. No one knows how many cars of freight will be loaded in any future week and no one knows the exact number of cars and locomotives. We can tell how many cars we have handled in the past, but that does not mean that more or less can be handled in the future. No fixed standard can be set because there are too many conditions that can change. The safe thing is to figure that there will be more business than we expect. Let us assume that there is so much business we will have to turn cars and locomotives faster than we have ever done before. We have passed through many years of transportation surplus. To pass from this condition to the other extreme which we have assumed suggests a little self- analysis and a look at our subordinate officers.

Have we older men let this period of transportation surplus create habits or practices that must be changed? Have our younger officers had most of their training during this period of surplus? We may have to change our way of doing things, and spend some time with our young officers to get them lined up. All this requires work. I doubt if we can do the job by writing letters. It will take personal effort and meetings to get things lined up. It will take continuous pressure to accomplish the desired results.

When heavy business is moving any road failure causes serious delay. It is important that units be carefully inspected before they leave terminals.

There is an old saying that "familiarity breeds contempt." Those who work with cars and locomotives must keep this in mind. Explore the possibilities of longer engine runs and other means of getting more service hours out of each locomotive. Do not let cars lie around waiting to be repaired. Load and unload cars promptly. Make regular checks and line up some plan so you will know personally that a real job is being done.

I suggest that you be neither pessimists nor optimists —just keep a straight course and deal with facts. Meet the situations that arise in the same cool, efficient way that you have in the past and, when all this noise about big business is over, you will see another record of a job well done.

Chairman Flynn's Address

The rapid expansion and tremendous acceleration of the National Defense Program has brought our railroads face to face with the problem of keeping ahead of the steadily increasing demand for cars and locomotives. Approximately 165,000 new freight cars of modern designs have been ordered by American railroads during the past 16 months to augment their existing equipment, and railroad freight-car repair shops are the busiest they have been in years. Reduction in the number of bad-order freight cars is progressing rapidly and it is imperative that the work continue with all speed.

Many new locomotives—steam and Diesel—of suitable capacity for the service required and thoroughly modern in design have been ordered, and the number of serviceable existing locomotives is, through extensive locomotive repair-shop operations, being steadily increased.

Passenger equipment cars have a very important place in the program of defense. While many new cars have been ordered, it is essential that the maximum possible number of existing cars be made ready for service and so maintained.

The greater dependability in service of cars and locomotives in use today, due to improvements in designs, materials, mechanical devices and standards of maintenance, in the bringing about of which the Mechanical Division has been actively engaged for many years, will be of material aid to providing the quality of transportation that is necessary.

A number of years ago the Mechanical Division appointed a Committee on Car Construction with directions to design standard cars which would be acceptable for general use. Resulting from the excellent work of this committee, and in which valuable assistance was rendered by the American Railway Car Institute representing car manufacturing companies, highly satisfactory designs for several types of cars have been produced. Many thousands of cars have been built from these designs and practically all box and hopper cars now being built are substantially in accordance therewith. In emergencies like the present when freight cars of standard types must be built in volume, the availability of these standard designs greatly overcomes delays incidental to development work in engineering of details and greatly facilitates obtaining the material required in construction.

Designs of new steam locomotives incorporate many improvements tending to insure greater reliability and more efficient performance, with a decrease in engine-terminal maintenance and an increase in availability. Longer range in operation where possible is being obtained by the application of tenders with greater coal or greater water capacities, or both. The development and extent of use of Diesel-electric locomotives are also progressing very rapidly.

Since the last meeting of the division much needed assistance in the handling of the many important matters coming before it for immediate attention has been provided in the creation of the office of executive vice-chairman. V. R. Hawthorne, secretary for nearly 22 years, was appointed to this new position, and A. C. Browning, assistant secretary also for nearly 22 years, was appointed secretary.

At the last meeting of the division you approved the adoption of new or revised loading rules without their submission to letter ballot. As will be brought out in the report of the Committee on Loading Rules, this has proved to be a great aid to the committee and with distinct advantage both to the railroads and the shippers.

Remarks by Commissioner Patterson

At the closing session of the meeting, W. J. Patterson, member, Interstate Commerce Commission, expressed his commendation to the committees for preparing the fine reports. He took exception, however, to a few specific items included in some of the reports, one of which was the conclusions reached by the Committee on Brakes and Brake Equipment with respect to the cleaning of AB brake valves equipped with strainers of improved design, which stated the three-year cleaning period was not only feasible but could be further extended. He was of the opinion that the three-year period allowed by present regulations might be too long. The AB valves tested, he continued, did not have high mileage nor were they subjected to severe atmospheric conditions.

Mr. Patterson commented on two public notices sent out by the Interstate Commerce Commission; one proposing a modification of Rule 23 (b) relating to tell-tale holes in flexible staybolts, the other modifying the rule on footboards of steam switching locomotives to permit a test application of a fabricated metal footboard. The modification to Rule 23 (b), he stated, will be placed in effect unless criticism is obtained, none having been received to date. He called particular attention to the modification of the rule governing footboards as the test application was to be made to only one Erie switching locomotive at Buffalo, N. Y. He requested the Mechanical Division to watch the performance of this test application during the authorized period which expires July 1, 1943.

The last item referred to by Mr. Patterson was the specifications for geared hand brakes. What means, he asked, is being used by the Mechanical Division to insure that these hand brakes meet the specifications? He thought it was important to test the geared hand brakes in order to make sure they complied with the requirements of the A. A. R. specifications.

Remarks by Roy V. Wright

In a brief address, Roy V. Wright, editor, *Railway Mechanical Engineer,* stressed the seriousness of the task with which railway men will be faced during the coming months. He opened his remarks with a reference to the grim determination evidenced by the various members of the Canadian government in a recent conference with a group of business paper editors from the United States and compared their unquestioning confidence in the outcome with that expressed by L. W. Baldwin.

Mr. Wright emphasized the importance of giving careful attention to the little things concerning which Mr. Baldwin had spoken. He suggested that if each repair yard, each shop, and each enginehouse were to do a little better, the cumulative effect would exert a large influence on the total transportation result. He suggested that the beating of its own record might well be made a game at each of these points all over the United States. Among the things he stressed particularly were the better utilization of existing equipment and materials and the development of more leadership in directing men.

Mr. Wright concluded his remarks with a strong appeal for stubborn courage in facing the difficult times ahead which, he said, was necessary if we are to win a victory for private enterprise and the American type of democracy.

Report of the General Committee

The General Committee reviewed the work of the Mechanical Division and its actions since the last annual meeting of the Division at Chicago in June, 1940. The membership of the division was reported to include 212 railway systems, full members of the Association of American Railroads, and 179 railways, associate members of the Association of American Railroads. These 391 railroads have appointed 818 representatives in the Mechanical Division. There are also 405 affiliated and 345 life members in the division.

As of December 31, 1940, the committee reported, a total of 443,484 interchange freight cars, or 22.17 per cent, were equipped with AB brakes. Of this total 411,672 were railroad-owned and 31,812 were private-line cars. AB brakes were reported as now being applied to existing cars at an accelerating rate.

The committee also reported that the service of the A. A. R. auto-deck has been entirely satisfactory in extensive tests with a large number of automobiles of various makes which have been followed through to destination.

A Study of Locomotive Utilization

The General Committee announced that the joint committee of the Operating-Transportation and Mechanical Divisions on the Utilization of Locomotives and Conservation of Fuel has undertaken a study of all of the conditions related to this subject, that a working sub-committee has been appointed to conduct the study and that a preliminary questionnaire has been sent to the member lines.

Research Office

The report reviewed the work of the mechanical engineer and his staff during the past year in which he has carried out a number of research projects assigned by the General Committee and has assisted in the work of the regular standing committees of the division.

Among the projects handled during the past year and being handled at the present time are the following:

Axle tests: material specifications for passenger cars; axles for heavy-duty service; tubular axles.
Trucks for high-speed freight service.
Counterbalance standards for locomotives.
A. A. R. auto deck.
Investigation of helical springs for freight cars.
Refrigerator Cars: effect of light cracks; use of dry ice as a refrigerant; use of portable refrigerator containers.
Wrought steel wheels; thin hub wall; reduced mounting pressures.
Tests for Committee on Loading Rules: tests of high tensile bands and wires; tests of welded band anchors.
Assisted in investigations in connection with concentrated loads.
Assisted in tests and preparation of rules governing loading of motorized and mechanized equipment for the U. S. Army.
Investigation of the characteristics of steel at low temperatures, particularly, couplers.
Cooperation with the Joint Committee on Relation between track and equipment.

Tests of crank pins will be started about July 1, 1941, at the axle testing laboratory, located at Canton, Ohio. The axle fatigue testing machines will be adapted for use in this research program.

Since the first of this year, this office has witnessed the squeeze tests of four new designs of passenger cars built to the A. A. R. Specification for New Passenger Equipment Cars.

Counterbalance tests of locomotives, together with rail stress tests, will be conducted during this summer in cooperation with the Engineering Division. Instruments to be used in these tests have been ordered and it is expected that the tests will be started about July 1, 1941. These tests will be under the general direction of the Joint Committee on Relation between Track and Rolling Stock of the Engineering and Mechanical Divisions and the Committee on Counterbalance Standards of the Mechanical Division and under the direct supervision of the Mechanical Engineer of the Mechanical Division and the Research Engineer of the Engineering Division. These tests will be concluded this summer and report will be available about the first of the year 1942.

Tests of tracking characteristics of various designs of freight car trucks, together with side bearing conditions, will be conducted this year under the general supervision of the Committee on Car Construction.

Report on Lubrication Of Cars and Locomotives

Dust Guards

In the 1939 annual report of the committee, a suggestion for revision of Specification M-903-34; Dust Guards, was included with recommendations that it be circularized among the members of the Association with a request that suggestions or criticisms be submitted for further study by the committee. This was done and the comments received through the secretary's office were considered, along with representative samples of dust guards on the market collected by them for study and test.

Recommendation: By action of the Lubrication Committee, concurred in by the Specifications Committee, a proposed revision of Specification M-903-41 Dust Guards, was made a part of this Report as Appendix A, and it was recommended that it be submitted to Letter Ballot.

Interchange Rule 66

Mandatory Features Relating to Lubrication—During the year, a number of subjects relating to proposed changes or additions to clauses of Rule 66, were referred to and handled by the committee as follows:

(1) *Standard method of packing journal boxes—Present "one-piece" vs. "roll" method.* This subject was continued from last year with the intention to carry on road tests under the direction of a sub-committee. After very careful consideration by the committee it was concluded that there is little difference in results obtained, providing comparable material is applied and equal care is taken with respect to the picking operation. It was decided that limited service tests would be inconclusive. The committee recommends no change in the present rule which leaves the method employed optional by designating that packing should be applied "preferably in one piece" (Par. 10(b)—Body of Packing).

(2) *Hollow back journal wedges—Removal from service when non-defective—Wear limits.* (The report of the sub-committee on hollow-back journal box wedges appears below.—EDITOR.) The Lubrication Committee advised the Arbitration Committee that the committee "sees no objection to individual car owners wearing out hollow-back or corrugated journal-bearing wedges under their own cars," inasmuch as the rules already prohibit their application in repairs to foreign cars.

It is recommended: (a) That the rules be so construed, and that wedges be not condemned merely because they are hollow back, unless defective under the provisions of Rule No. 66 (k).

(b) That the second sentence of Paragraph 12 of Section of Rule 66 covering "Journal Boxes—Standard Method of Packing," reading: "The use of hollow back or corrugated back wedges is not permitted," be deleted. This sentence is unnecessary, as Interchange Rule No. 19 covers.

(3) Recommendation to prohibit use of front plug in packing of Journal Boxes. The Car Department Officers' Association, at its 1940 annual meeting, recommended to the A. A. R. Mechanical Division that the use of the front plug in packing journal boxes be prohibited. This recommendation was referred to the Committee on Lubrication of Cars and Locomotives for handling. After full discussion, it is the consensus of opinion of the committee that the present Rule, which makes the practice optional, is desirable and should be continued.

Subcommittee Report on Hollow Back Journal-Box Wedges

The subcommittee reviewed a number of hollow-back wedges removed from Pennsylvania freight cars in service, as well as wedges of various designs, having hollow backs, removed from cars of other railroads and car lines. A list of wedges examined, was included in the report and photographs of representative types are shown.

Most of the so-called hollow-back wedges are forgings, and in a few cases steel castings, with depressions in the back. There are also still in service a number of U. S. R. A. cast wedges with cored backs, but which have the external contour of an A. A. R. standard wedge. These wedges were originally applied to the freight cars built in the years 1919-20 by the United States Railroad Administration.

The subcommittee recommended the following reply to the secretary concerning the submission from the Arbitration Committee:

"The Lubrication Committee sees no objection to individual car owners wearing out hollow-back or corrugated-back journal bearing wedges under their own cars, inasmuch as the rules already prohibit application in repairs to foreign cars. We recommend that the rules be so construed, and that such wedges should not be condemned merely because they are hollow back, unless defective under Rule 66-K."

Passenger Equipment Cars—Rules PC-7 and PC-8

(1) *Responsibility for damage due to failure of roller bearing units under passenger cars.* The Arbitration Committee's recommendation for revision of passenger car Interchange Rules 7 and 8, to provide that the failure of roller bearing units, or combination roller bearing units and friction bearing units, due to defects or over-heating, will be classified as car owner's responsibility, was concurred in by the Committee on Lubrication of Cars and Locomotives.

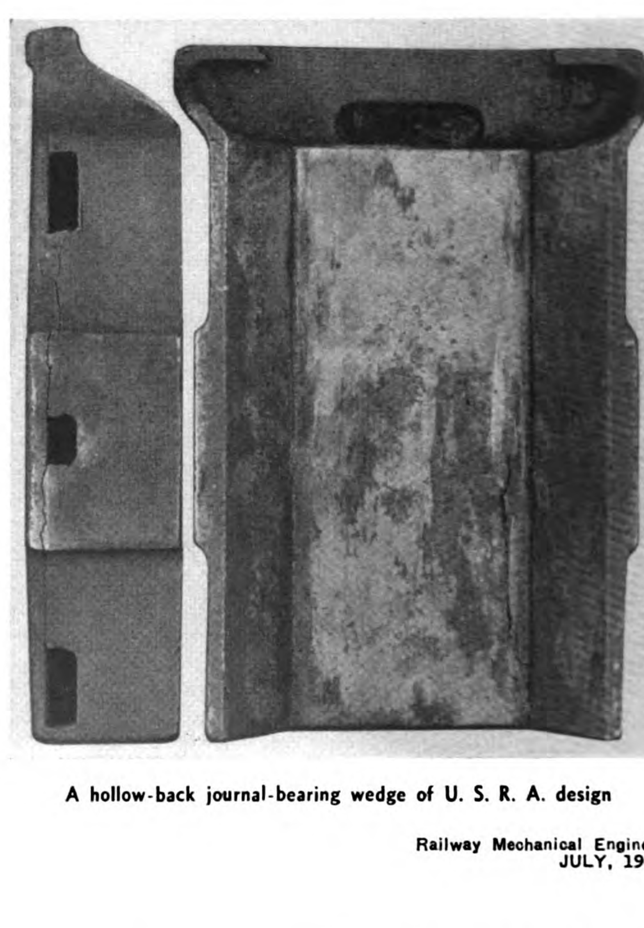
Lubrication of Railway Roller-Bearing Equipment — Lubricants and Practices

At the present time there is a wide variation in the specifications of the numerous oils approved or recommended by the roller bearing manufacturers, and even for use on the same bearings on different railroads. The committee feels that a general specification for oils for roller bearings is desirable and will endeavor to include this in the report for next year.

Special Journal-Box Lubricators

This subject has been before the committee for a number of years and was last reported on in the 1939 annual report where specific reference was made to engine truck journal lubricators and a number of special lubricators were described and illustrated. In an endeavor to keep abreast of new developments in this field, correlate the results of service test or experience reported by member roads, and make report from time to time as developments in the field warrant, the subject this year was assigned to a sub-committee. The sub-committee reports:

"One member road has had limited satisfactory experience with a journal lubricator pad not heretofore mentioned in reports of this committee. This is a spring actuated pad, adaptable for



A hollow-back journal-bearing wedge of U. S. R. A. design

use in existing journal boxes and can be applied or removed without removing the bearing or the wedge. This pad was designed with the idea of reclamation or cleaning for reuse and it is claimed that the coil spring laid in a horizontal direction exerts constant pressure of very low magnitude against the journal.

Joint Sub-Committee on Journal-Box Lubricating Materials

A joint sub-committee consisting of membership from the Specifications and the Lubrication Committees has handled two matters during the year.

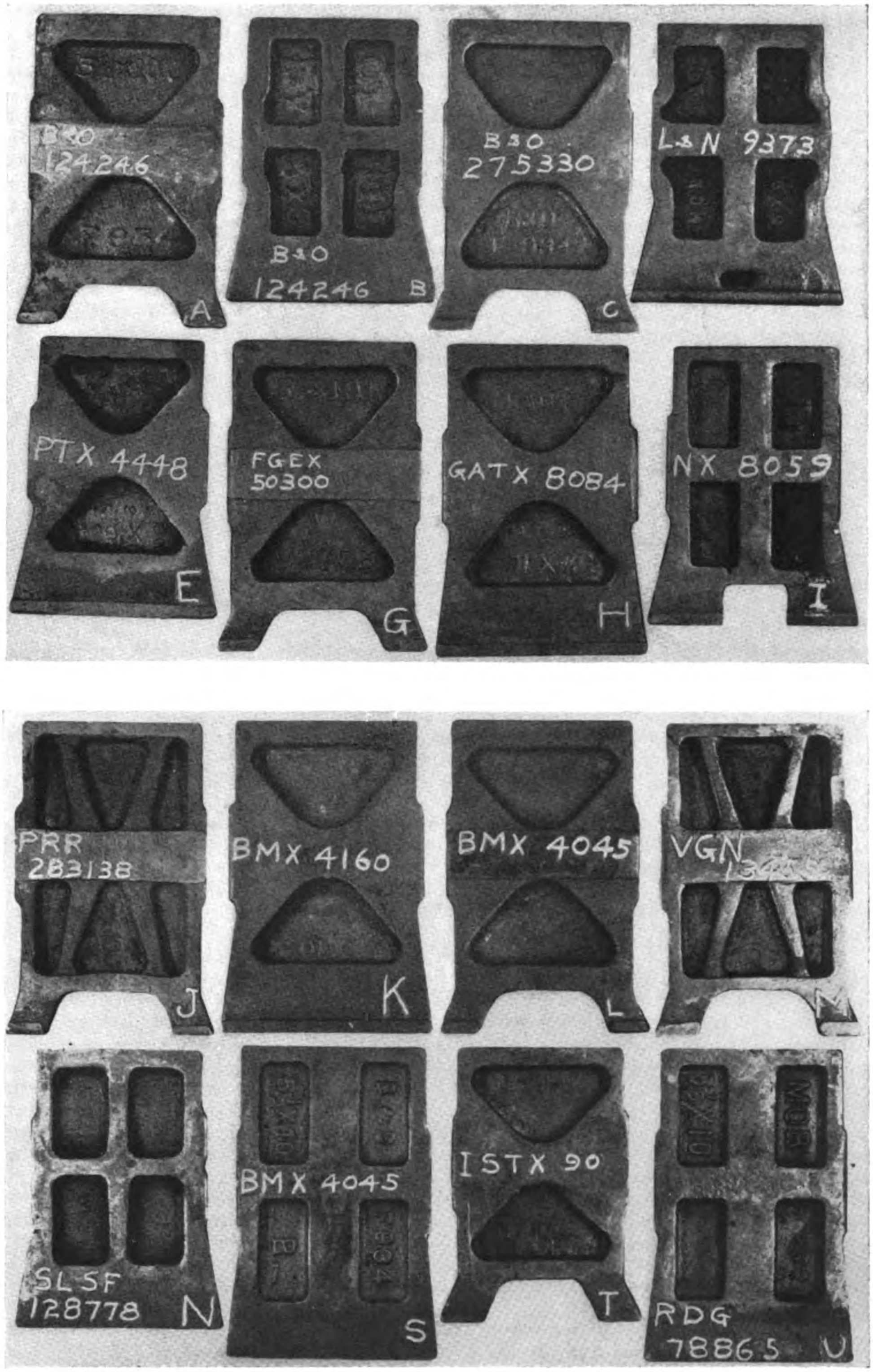
Proposed Revision—Specification M-905

At the suggestion of the chairman of the Committee on Specifications for Materials, revision of Specification M-905-34 was undertaken by the joint sub-committee.

Recommendations: By action of the Specifications Committee, concurred in by the Lubrication Committee, proposed revision of Specification M-905-41; New Waste for Journal Box Packing. [This was made a part of the report and it was recommended that it be submitted to letter ballot.—Editor]

Proposed Specifications Covering Lubricants for Air-Brake Apparatus

Specifications for triple valve oil, triple valve graphite and brake-cylinder lubricant: originated by the Committee on Brakes and Brake Equipment, were referred to the joint sub-committee through the Specifications Committee.



Recessed - back journal - bearing wedges removed from various cars

Recommendations: Action of the Specifications Committee, concurred in by the Lubrication Committee, on the proposed specifications for Lubricants; Air Brake Parts, was as follows:

1. Specification M-912-41; Triple-Valve Oil, approved with the recommendation that it be submitted to letter ballot.

2. Specification M-913-41; Triple-Valve Graphite, approved with the recommendation that it be submitted to letter ballot.

3. Specification M-914; Brake-Cylinder Lubricant: A draft of the proposed specification, submitted by the Joint Sub-Committee, was referred back to the Joint Sub-Committee for further study and report.

Diesel-Locomotive Crank-Case Lubrication—Lubricants and Practices

This subject has been assigned to a sub-committee for study this year and, through a questionnaire to be sent out to the locomotive voting members, the sub-committee hopes to develop material for a report on this subject next year.

Joint Sub-Committee on Journal Boxes and Contained Parts

A joint sub-committee consisting of membership from the Car Construction and the Lubrication Committees, has made some study of several details in connection with modification of parts of the journal-box assembly: box, wedge, and bearing. A number of the changes relating to the question of lubrication have been considered by the Lubrication Committee or its representatives on the joint sub-committee. In all cases, however, the proposed modifications involve dimensional changes and design of parts which come under the jurisdiction of the Car Construction Committee and will be handled by that committee.

The report was signed by J. R. Jackson (chairman), engineer of tests, Mo. Pac.; P. Maddox, superintendent car department, C. & O.; A. J. Pichetto, general air brake engineer, I. C.; L. B. Jones, engineer of tests, Pennsylvania; W. G. Aten, mechanical inspector in charge of lubricating matters, C. B. & Q.; J. Mattise, general air brake instructor, C. & N. W., and J. W. Hergenhan, assistant engineer, test department, N. Y. C.

Discussion

In presenting this report, Chairman Jackson said that, owing to the existence of a certain amount of hazard in connection with the Sligh oxidation test for triple valve oil, referred to in Exhibit B, Sec. 4, a precautionary clause designed to eliminate this hazard is being included. He said that under Specification M-914, in no case should either alcohol or ether be used in cleaning air brake valve parts.

J. McMullen, superintendent car department, Erie, called attention to the necessity for high-speed movement of freight cars without delays due to hot boxes which, assuming an average of 30 minutes for each, appreciably reduce potential transportation service. Mr. McMullen referred to tests which the Erie is conducting with a special journal bearing in which the babbitt lining is interlocked with the bronze back and suggested the more extensive use of this bearing with a view to eliminating hot boxes due to loose or flowing journal brass linings.

P. P. Barthelemy, master car builder, G. N., voiced objection to hollow-back wedges and asked if any study has been made of flame hardening.

In answer to the first question, Mr. Jackson replied that the committee's recommendation was made with a view to conserving material and that some of these wedges have been in service for as long as 20 years without trouble. He said that the flame-hardening of wedge bearing surfaces would in all probability cause excessive wear in the journal box roofs.

H. W. Coddington, chief chemical and test engineer, N. & W., said that loose journal-brass linings may possibly be due to imperfect bonding, and mentioned a machine which has been developed on the Norfolk & Western for actually measuring the bond strength between the brass body and the lining metal. As a result of the use of this machine, the N. & W. journal-brass specification calls for a definite bonding strength and has helped increase the number of miles per hot box. Mr. Coddington said that he would make available to the Mechanical Division committee data regarding flux material which has been found to give good results.

J. E. Mehan, assistant to superintendent car department, C. M. St. P. & P., called attention to the omission of any reference to dust-guard plugs in the committee's specification and Mr. Jackson said that this does not imply elimination of dust-guard plugs which are amply covered in Interchange Rule 66.

E. B. Hall, chief mechanical officer, C. & N. W., asked why no mention was made of defective oil-box covers and Mr. Jackson replied that improvement in this detail of design is a responsibility of the Committee on Car Construction, but his committee will also be glad to give it consideration in the coming year, if it is found desirable.

C. D. Stewart, chief engineer, Westinghouse Air Brake Company, said that a comprehensive brake-cylinder lubricant specification is necessary to assure adequate lubrication for a long period and that this same lubricant obviously should be used at repair points. Recalling that Type-K freight triple valves were originally designed for 12 months' operation without lubricating attention, this period being subsequently extended to 18 months, Mr. Stewart said that the Type AB equipment is aimed at three years' service. Practically complete protection from dust and dirt assures low friction during this period and the type of lubrication selected is designed to last for at least 36 months. He said that laboratory tests have shown the adequacy of the Sligh method of testing triple-valve oil.

The report was accepted.

Brakes and Brake Equipment

Elimination of excessive leakage of air from the brake pipe has for many years in the past, and is continuing to be, of paramount importance to the operation of and proper control of brakes on freight trains. Experience has indicated that a considerable amount of brake pipe leakage occurs at the air hose couplings.

Our 1937 annual report showed a picture of and suggested the use of an air hose coupling testing device for submerging the coupling under water and testing before mounting it on the hose. Since that report was made there has been considerable more work done with this device. There have been a number in service for several years and the results have been very gratifying.

Instructions for Use of Testing Device for Air-brake Hose Couplings

When a coupling is cleaned and ready for test, try to apply it to the no go gage which can be rigidly attached to the corner of the tank. If the coupling will go on this gage, it must be rejected.

If the coupling will not go on the gage, apply the combined go gage and dummy coupling to it. If the coupling refuses to take this gage freely, it must be rejected.

With the combined gage and dummy coupling applied, place the coupling nipple shank in the chuck which will be locked in its upper position by the latch on the handle engaging the bead on the rim of the tank, and move the holding hook of the chuck into engagement with the coupling stop pin. The exhaust cock will then be closed and the supply cock opened so as to connect air pressure at 70 lb. to the chuck. The air pressure will then register on the gage, cause the chuck to grip the coupling shank with an air-tight fit, and be connected to the inside of the coupling.

Then examine the coupling for audible leaks, unlatch the handle, rotate the chuck until the coupling is submerged. Bubbles will indicate leakage which can be located by slowly raising the coupling to the point of leakage.

If leakage occurs at the gasket groove, remove the gasket and make certain the groove and gasket are clean and then retest. If the leakage persists, the coupling must be rejected. If leakage occurs as a result of porosity of the coupling casting, it may be lightly peaned. If the leakage persists, the coupling must be rejected.

Couplings should be free from leakage but they need not be condemned for minor leakage as disclosed by bubbles that develop very slowly. In such cases, close the air supply cock and observe the air pressure gage. The leakage must not exceed a drop of 4 lb. from 70-lb. pressure in one minute.

We believe that the use of the above device will eliminate the leaking couplings from service, before they are mounted on the hose, thereby greatly reducing ever present brake pipe leakage,

assist in the reduction of train delays and produce better control of train brakes.

We, therefore, recommend the adoption of this device as recommended practice.

Modification of Freight Retaining Valve

New Slow-Release Retaining Valve

The 1940 annual report contained a brief reference to the redesign of the freight retaining valve in order to provide additional protection and variable control of brake cylinder pressures. During the past year further study has been made of the new four-position Slow Release Retaining Valve for freight service.

This new slow-release retaining valve has four positions instead of three. Three of the positions, however, produce exactly the same results as the present A. A. R. standard retainer, that is—direct exhaust with handle in the vertical or down position; high-pressure retain (nominal 20 lb.) in the 45-deg. position; and low-pressure retain (nominal 10 lb.) in the 90-deg. or horizontal position. The fourth position is with the handle at 45 deg. above the horizontal and known as slow-direct-exhaust position. In this position the brake cylinder is connected to atmosphere through a No. 60 drill orifice which permits the normal cylinder volume to blow down from 50 lb. to 10 lb. in approximately 86 sec. and will continue to exhaust until the brake is completely released without turning down the retainer.

The road service tests disclosed that the No. 60 drill orifice provides a sufficiently slow release to avoid harsh train slack movement when releasing the brakes on comparative long trains while in motion.

In addition to the new fourth position and its operating feature the new retainer has certain desirable constructional features such as: (a) The bracket is arranged for permanent mounting to the car body with the valve body bolted to it so that the valve can be easily removed for cleaning or repairs without disturbing the pipe connection. (b) The valve is protected from pipe scale and dirt by a readily renewable strainer and (c) The exhaust ports are protected from wasps entering the valve by a wasp excluder built into the body.

This valve retains all of the features of the present A. A. R. standard and, in addition, includes a fourth position giving a continuous blown down of brake-cylinder pressure to zero pressure for the purpose of providing means for accomplishing improved control of the slack action of freight trains during release of train brakes while in motion, which will result in outstanding operating economies in time and cost, indicated by the following:

(a) Decrease frequency of stoppng trains to set up and turn down retaining valves under certain now existing operating conditions.

(b) Decrease frequency of stopping trains to release brakes at lower speeds than is now common practice.

(c) Decrease damage to equipment and lading resulting from improved train slack control when releasing brakes on maximum long trains in *level* grade operation.

(d) Accomplish smooth train slack control on generally descending and perhaps undulating grades which may contain sections of adverse grades and without changing the retaining valve setting between terminals.

We recommend that the new four position slow release retaining valve be adopted as recommended practice.

Modification of Present Standard Retaining Valve

If the above recommendation is favorably received, the present A. A. R. Standard Retainer can be readily converted to include the fourth position with the same advantages as above outlined. [An outline drawing and diagrammatic of a standard retainer modified to include the slow-direct-exhaust position as well as a wasp excluder and vent protector was included in the report.—Editor.]

We recommend that this conversion be adopted as recommended practice for present equipment, provided the above recommendation for new cars is adopted.

Wasp Excluder and Vent Protector

In our annual reports of 1939 and 1940 reference was made to an improved design of wasp excluder, for the present retaining valve, in which complete protection is provided against mud-wasps restricting or completely plugging the exhaust ports, together with complete protection against ice, sleet or other elements, thus avoiding wheel damage and improper release of the brakes.

We also made reference to a molded rubber sleeve to fit over the low pressure cap of the retainer as a means of overcoming wheel troubles caused by moisture entering the valve, causing corrosion and stopping up of the small relief part.

We now wish to report that as a result of our investigation and observations of those in service we recommend the use of this type of vent port protector and the rubber-disc type of wasp excluder in lieu of all previous types submitted.

Cleaning, Testing and Lubricating of AB Valves

During the past year we have made very extensive tests and inspections of 100 Pennsylvania cars and 100 Santa Fe cars that were equipped with AB Brakes and marked "AB Brake—Experimental," having the improved types of bracket strainers.

The average service period of the 200 cars involved was 43 months. The results of the tests and the condition of the valves and equipment as a whole were very gratifying. Tests of complete trains of 100 cars each made before the equipment was disturbed, but as represented by an average service period of 43 months, revealed proper operation after light and heavy service applications and emergency applications as well as the releases.

On rack tests and visual inspection it was revealed however, that there was some restriction of the service portion feed grooves and the quick action chamber charging chokes. We concluded from the results, however, that the present three year cleaning period is not only entirely feasible with valves equipped with the improved strainers, but could be further extended.

Our complete report on this subject with definite recommendations has already been submitted to the General Committee for their consideration.

Standard Brake Beam

Your committee has been making a study of the detailed causes of brake-beam failures and after compiling the data taken from reports of over 34,000 beams removed on various railroads it is interesting to note that worn heads comprise 47.4 per cent of the removals, 26.35 per cent tension rod defects, either broken, bent or loose rods or nuts missing. The other 26.25 per cent miscellaneous defects. The three outstanding defects for beam removals are brake head worn at toe, 15.47 per cent; brake head worn at center lug, 13.9 per cent, and tension rod broken at thread, 13.84 per cent.

We are not in a position to make a definite recommendation in connection with this subject, but it is very evident that drastic action must soon be taken to curb brake-beam failures.

Passenger Car Steam Connectors

The report includes a drawing showing the dimensions for the 2-in. passenger-car steam coupler head similar to that now shown as standard on page 78 of Sec. E of the Manual, except for the addition of grooves to the head to make same suitable for interchange of either the Vapor Car Heating Company's or the Gold Car Heating and Lighting Company's gaskets which employ different methods of locking same in coupler head. The committee recommends the substitution of this figure showing these grooves in place of present page 78 of Sec. E. of the Manual as Standard.

Emergency and Service Pistons for AB Brakes of the Self-Lubricated Type

In order to provide proper lubrication of the service and emergency pistons of the AB valve over extended service periods a considerable amount of development work has been done with a self-lubricated type of piston. This piston contains an oil chamber with a capacity of approximately 300 drops of oil, which is fed to the piston ring and ring groove in very minute quantities.

There have been a limited number of pistons of this type in service for more than two years and the results have been very encouraging.

The air-brake manufacturers have expressed their willingness to absorb the extra cost involved to make the AB valve with self-lubricating pistons available at no increase in price over the AB valve with the present type of pistons, for all new valves

manufactured after a given date, due to the fact that certain reductions in manufacturing cost have been made possible by the elimination of the by-pass check valves and their related parts. The air-brake companies also have stated that the development work and experience which they have had allows them definitely to recommend the use of these pistons and are willing to insure their proper operation.

Inasmuch as your committee has already recommended that authority be extended to permit the use of these pistons to all roads which desire such equipment without limitation; due to the fact that the self-lubricated piston can always be operated the same as the present piston, simply by the removal of the oil, if the occasion should demand; and due to the above assurance and statements made by the air-brake manufacturers, we wish to recommend the adoption of the self-lubricated type of service and emergency pistons in all AB valves manufactured after a certain date, which date should be the earliest practical date that the manufacturers can get in production.

Both air-brake companies are prepared to furnish a common standard for new valves.

We are also studying the possibility of converting the present pistons which are in service to pistons of the self-lubricated type, but to date we can offer no definite recommendations for this conversion.

Different length piston stops are required with the AB test rack when testing portions equipped with self-lubricated pistons than when testing portions with standard pistons.

Use of Hollow Type Plugs

It has been brought to our attention that there have been cases of train delays and damage to equipment resulting from emergency applications caused by some flying object from the roadway striking the pipe plug applied in the bottom of the Type K triple valve. These were the hollow type pipe plugs instead of solid type.

We were advised by the air-brake manufacturers that they have been for some years, and are now using solid type pipe plugs.

We recommend the use of a solid type pipe plug when a pipe plug is used on any part of the air brake equipment and any of the hollow type now in service to be replaced with the solid type.

Excessive Wear in AB Valve Release Handle

The hole in the reservoir release valve handle of the AB valve for the insertion of a cotter pin to secure the release rod is a 9/32-in. drilled hole. It was the intent when providing this size hole that a 1/4-in. cotter pin was to be used at this point. It has been noted that a considerable number of 7/32-in. cotter pins and some 1/8-in. cotter pins are being used for this purpose rather than the 1/4-in. which practice allows movement due to vibration and causes excessive wear of the handle and cotter pin.

It is recommended that 1/4-in. cotter pins only be used at this location and that all valves in service having smaller than 1/4-in. be replaced when they are on repair tracks.

Combined Dirt Collector and Cut-out

Difficulties have been encountered in operating the branch-pipe cut-out cock in the combined dirt collector and cut-out cock of the AB brake equipment, due to high friction between the plug cock and the body. The high friction is caused by the accumulation of rust and the infrequent number of operations.

Tests made on 200 cars revealed that a pull of over 360 lb. was required near the end of the cut-out cock handle on 18 cars to start movement. On the remaining 182 cars an average pull of approximately 133 lb. was required, which is considered to be in excess of the pull capable of being exerted at this point by an average man. The resistance to start of movement is approximately 45 per cent higher for those units on refrigerator cars than for those on box cars.

The cast-iron body of the present standard unit forms the seat for a brass plug with an enlarged water-way. The manufacturers of this unit have found it possible to equip the standard body with a brass bushing forming the seat for a smaller plug but with sufficient size water-way so that there is no detrimental effect on the performance of the complete brake equipment.

The use of the brass brushing to prevent such corrosion as was present with the cast-iron seat and the reduction in radius of the plug with the same length handle will without a doubt reduce the pull required to start the movement of the cut-out cock and should correct the difficulties encountered.

We have approved this new design of combined dirt collector and cut-out cock for use in interchange as a permissible substitute for the present standard. If further experience proves the adequacy of this unit we shall then, no doubt, recommend its use as standard.

The report was signed by R. E. Baker (chairman), general supervisor of air brakes, air conditioning and power plants, B. & M.; J. A. Burke (vice-chairman), supervisor of air brakes, A. T. & S. F.; W. H. Clegg, general superintendent of motive power and car equipment, G. T. W.; T. L. Burton, air-brake engineer, N. Y. C.; C. H. Rawlings, superintendent of air brakes, D. & R. G. W.; R. J. Watters, general air-brake inspector, Nor. Pac.; Otto Swan, air-brake instructor, U. P.; J. P. Lantelme, general foreman, Pennsylvania; J. Mattise, general air-brake instructor, C. & N. W.; R. E. Anderson, general air-brake inspector, C. & O., and R. N. Booker, general air-brake inspector, Sou. Pac.

Discussion

E. B. Hall, chief mechanical officer, C. & N. W., complimented the committee on its report, but said that it fails to mention a number of things which cause a lot of delays on railroads, such as improper anchorage of brake pipes.

W. E. Vergan, supervisor of air brakes, M-K-T, said that he is in favor of the hose-coupling test device, described in the committee's report, which will lessen the time required for testing, as compared with the device submitted in 1937. He suggested that the use of the improved device be made mandatory instead of recommended practice. Referring to the modification of the retaining valve, Mr. Vergan said that the choke feature should be made available quickly and easily by simply turning a retaining valve handle, thus enabling trainmen to secure maximum benefits in operation. Mr. Vergan stated that slack action can and should be controlled now, not only in long trains but in short trains, especially those operating over hilly country where slack has a tendency to run in and out. He is in agreement with the balance of the committee's report but feels that the Type AB equipment should be good for five years without intermediate inspection and lubrication attention.

In closing the report, Chairman Baker said that the committee is studying the question of proper pipe-clamp design and, in response to a comment by I. C. Bond of the Wabash, regarding the superiority of the No. 3 brake beam with 1 3/8-in. rods, said that the committee is also giving consideration to the subject of improved brake-beam performance in conjunction with a committee representing the manufacturers.

The report was accepted and recommendations ordered submitted to letter ballot.

Couplers and Draft Gears

No new certificates of approval for draft gears have been issued during the past year, and the number of approved gears remains at twelve. These are made by six different manufacturers. Two of these approvals are conditional, which signifies that they cover new designs of gears whose service performance will be watched in order to see if unconditional approval is merited.

The two year period for conditional approval has expired for the Waugh-Gould Type 410 gear. No action has been taken to change the status of this gear, since the manufacturer advises that there have been only five of them sold. One of the purposes of conditional approval is to exercise some restraint on the number of gears of a new and untried type which might be placed in service, so that if some defect shows up which the laboratory did not reveal, there will not be an undue burden placed on the railroads.

It has been found that manufacturers desire to maintain unchanged the type designation of an approved gear if an improvement is made, this for the purpose of avoiding the disadvantage of a lower interchange price if the former designation is placed in the non-approved classification. Obviously a bad situation would be created for the railroads if gears of different construction were permitted to retain the same type designation. On the other hand, the Committee feels that everything possible should be done to encourage the manufacturers to make improvements

in existing approved gears, and there should be no penalty imposed on any manufacturer who does this, or on his customers. In order to overcome this difficulty it is proposed to establish a new classification for approved gears, to be designated as "Superseded Approved Gears." If modifications are made in an approved or conditionally approved gear, a new type designation will be required and the former type designation will be placed in the "Superseded Approved" classification. Gears in this classification will have the same interchange status as "Approved Gears" and will remain in this classification until they become obsolete.

The manufacturer of the Peerless H-1 gear made application for approval of a change in the housing construction, this change consisting of the addition of ribs on the outside of the housing to facilitate substitution for other types of gears in interchange repairs. Subsequently a second application was made covering a change in the design of these ribs, after the first design had been approved without requiring any tests to be made. Suggestions have been made concerning this second design of ribs, and when these are complied with this change will be approved.

The manufacturer of the Westinghouse NY-11-E and NZ-11-E gears has made application for approval of new designs of housings for these gears. These new designs will give housings weighing less which it is claimed are stronger than the previous housings. Since the new housings involve no change in the friction parts of the gear, it has been decided that their suitability can be determined by subjecting three gears of each type to the preliminary, capacity and sturdiness tests. This will be done as soon as test specimens can be obtained.

Check Tests of Approved Draft Gears

During the year a partial retest of one approved draft gear was made in accordance with decision reached after the series of check tests referred to in the report for the past two years. As a result of this retest the certificate of approval was reissued to cover changes that had been made in the manufacture of the gear.

A second type of gear was required to undergo a complete new approval test as a result of its showing in the previous check test, and the manufacturer has filed his application for this new test. Before supplying test specimens he desires to check the effect of modifications in design by making private tests under the Association's drop hammer, and this work has been going on practically continuously since last July. Latest advice is that the manufacturer is about ready to proceed with construction of a lot of gears embodying the newest features, and when these are ready test specimens will be selected.

A new check test of approved gears has been conducted during the past year. The first check test was made on seven types of gears, the other five types of approved gears being omitted either because of their similarity in design to a type included or because they had just recently been approved. Five of these seven types of gears were included in this second check test, the other two types getting special treatment as referred to in the two paragraphs above. The gears included in this second check test, known as the 1940 Check Test, consisted of the following types: Edgewater B-32-KA; Miner A-22-XB, Cylinder D-7935; National M-17-A; Waugh-Gould 403; Westinghouse NY-11E.

Three gears of each of these types were selected from stock at the manufacturer's plants without advance notice being given when selection was to be made. It was quite noticeable that these gears were superior to the gears secured for the 1938 check test. The parts of the gears were in closer conformity with the manufacturer's drawings which are on record, and the workmanship was better. This was probably a result of the criticisms made after the last test. The gears were in better shape as regards the condition of the friction surfaces, which would be expected from gears taken out of manufacturer's stock. Each of the five gears tested complied with specification requirements in all essential respects, in fact, the performance of the gears in these check tests was in only a few respects less satisfactory, and in some respects more satisfactory, than in the official tests upon which original approvals were based.

Each manufacturer will be advised of the results from the check test of his gear, and such minor discrepancies as were found will be called to his attention for appropriate action.

It is recommended that at the first opportunity the association provide for a series of capacity checks of approved draft gears taken from cars in service. The purpose of these tests would be to secure information as to how the capacity of the gear has stood up in service and its relation to the age of the gear, and to the capacity of new gears obtained in laboratory test. It would show if there is any value in the process of working-in used during manufacture, or if this merely establishes a fictitiously high capacity which disappears after the gear goes into service.

Recommended Changes in Draft-Gear Specifications

Based largely on observations made during the conduct of the two series of check tests of approved draft gears, it is recommended that the following changes be made in Specifications M-901-37 covering Approved Draft Gears for Freight Service:

1—Insert a new Par. 3 (e) as follows:

"The surfaces on which the gear closes are to be reasonably parallel, and shall be perpendicular to the axis of the gear."

The purpose of this provision is to avoid the introduction of any cocking action when the gear closes, which might throw the action of the forces out of line with the car sill.

2—Insert a new Par. 8 as follows, renumbering the present paragraphs accordingly: "Test for Capacity as Received—Before a gear in disassembled for internal measurement its capacity shall be determined in as few as possible drops of the 27,000 lb. tup in order to establish what capacity it has in the condition as shipped by the manufacturer. To be acceptable each gear must show not less than 15,000 ft. lb. capacity in this test." The purpose of this requirement is to insure that draft gears will be properly worked in during the process of manufacture, so that they will afford full car protection as soon as they are installed.

3—Add the following sentence to the end of Par. 3, Appendix A: "Specification for the working-in process, if any, used during the manufacture of the gear, including limits for acceptability of assembled gears, shall also be furnished." The purpose of this requirement is to place this information on record so that if any change in procedure is made the Association will be advised.

It is recommended that Par. 3 (a) of Spec. M-902-37, Purchase Specifications for Approved Draft Gears for Freight Service, be rewritten to agree with the corresponding paragraph in Specifications M-901-37. In the purchase specifications the outside measurements of the gear are designated as such that will permit it to be installed in a pocket the size of which is given, while in the regular specifications the actual measurements for the gear are given.

Tests of Waughmat Draft Gear for Freight Service

The Waugh Equipment Company has developed a rubber draft gear for freight service and has asked for approval for its installation. It is designed for installation in the standard draft gear pocket. Because its characteristics differ greatly from those of friction draft gears, it has been necessary to proceed differently in the matter of approval. Laboratory tests of an exploratory nature, including all of the regular specification tests, have been made under the Association's drop hammer, and car impact tests will be made under the supervision of the sub-committee. Approval has been given for the installation of a limited number of these gears in actual service, and their performance will be closely checked by the committee. The outcome of these investigations will determine the future course of action regarding this gear.

Tight-Lock Couplers Opening in Service

Our report for the year 1940 called attention to some trouble experienced with tight-lock couplers separating in service. It was the opinion of your committee that in view of the investigations made concerning these partings and the corrective measures applied, as well as tests made at that time, the trouble had been definitely corrected. However, during the past winter several additional separations involving tight lock couplers have been reported.

Careful investigations have been made of each of these partings and the manufacture and gaging of the couplers at the plant of the manufacturer. It has been definitely established that the partings were practically confined to tight-lock couplers cast prior to January 1, 1939. The known exceptions are a few partings involving tight-lock couplers manufactured since January 1, 1939, in which the anticreep arrangement had not been properly adjusted. A study of the individual couplers involved in these

separations has shown that these partings would not have occurred had the instructions been properly understood and the corrective measures outlined in the 1940 report been properly performed, especially as regards the adjustment to the secondary anticreep shoulder in the bar.

A joint meeting of your committee with the Mechanical Committee of the Coupler Manufacturers was held in Cleveland on February 27, 1941, at which time this subject of tight-lock coupler separations in service was thoroughly reviewed. At this meeting arrangements were made whereby the coupler manufacturers' representatives were to cooperate further with the railroads in checking tight-lock couplers cast prior to January 1, 1939, and to give instruction and assistance to make further corrective adjustments to the anticreep arrangement in the couplers where necessary.

The Mechanical Committee of the Coupler Manufacturers has prepared Circular No. 441 which shows in full-size arrangement the anticreep feature of the tight-lock coupler, the gages necessary to make these adjustments to the anticreep arrangement, including also detailed instructions covering the procedure to be followed in making these corrections. All this information has been made available, through the manufacturers, to the railroads having tight-lock couplers in service.

Maintenance Knuckle for Tight-lock Couplers

Tight-lock couplers manufactured prior to January 1, 1939, were produced without the benefit of machining important bearing surfaces and with more or less incomplete gaging practice. As a result of this early production practice such couplers are not uniform as regards interchange of parts, especially knuckles. These early knuckles may occasionally require replacement and when replaced with the latest standard knuckle the contour line may be a little too tight and cause difficulty in coupling with another tight-lock coupler.

The Mechanical Committee of the Coupler Manufacturers has given this subject careful attention and recommends that tight-lock knuckles furnished the railroads for maintenance should have the thickness of the knuckle reduced 1/16 in. by machining the metal from the pulling face. This change would provide approximately 1/16 in. clearance in a coupler having normal dimensions, but in many of these early couplers this proposed knuckle would provide a closer fitting contour than would be the case with the original knuckle that is being replaced. These knuckles will be furnished only for maintenance purposes and no change is being made in the standard knuckle furnished with new couplers. The catalog number of the standard tight-lock knuckle is T50 and for identification purposes the maintenance knuckle will bear the identification T50A.

Arrangements have been set up by the coupler manufacturers to have the standard tight-lock knuckles, now carried as spares by the railroads, returned to the manufacturers for machining of the face, which machining will be done free of charge.

On account of the necessity for prompt action your committee has authorized the coupler manufacturers to proceed accordingly, subject to your approval.

Contour Maintenance for A.A.R. Tight-Lock Couplers

To insure satisfactory inter-coupling between tight-lock couplers, where any repairs have been made to coupler body or parts, a simple contour gage has been provided. This gage will be furnished by the coupler manufacturers on orders.

Tight-Lock Coupler Specification

Last year, your committee presented specifications for tight-lock couplers and attachments with the recommendation that these specifications be referred to the Committee on Specificaions for Materials for approval and then submitted to letter ballot.

The Committee on Specifications for Materials did not approve the specifications as presented by the coupler committee on the grounds that couplers and coupler parts were steel castings and the material used in such parts should be incorporated in the specifications covering steel castings.

Your committee does not look at this proposition in the same light as the material specifications committee, since couplers and parts could not be considered as a general run of steel castings, but represent more particularly a highly specialized product in which only a limited number of manufacturers are engaged in their production.

In view of the important part couplers play in our transportation system and the highly specialized nature of their manufacture, it is the opinion of your committee that all of the requirements surrounding the production of couplers and parts should be incorporated in a single specification.

The tight-lock coupler specification was submitted to letter ballot vote last year and approved. The matter of form for inclusion in the A. A. R. Manual was further discussed with the Committee on Specifications for Materials without agreement being reached. In view of the importance of the specification, it has been placed in the Manual of Standard and Recommended Practice in separate form, pending further conference with the specifications committee.

Protection of Coupler Operating Mechanism

The investigation to develop a suitable means for the locking of coupler operating mechanism to prevent accidental opening of the coupler in service resulting from obstacles striking the operating lever is still in progress. It would be a simple procedure to lock the uncoupling rod and bail securely if the couplers were operated from one side only, at each end of the car. Also, an automatic locking side bracket could be used securely to lock both side operating rods individually. However, complications arise when an attempt is made to lock both the side operating rods and the bail, as a unit, at each end of the car when the operating arrangement is designed to operate from both sides of the car.

A questionnaire has been sent to the membership requesting an expression regarding a preference as to whether coupler operating mechanism on passenger cars should be operated from one side, only, or from both sides of the car. Replies to this questionnaire have not furnished as much information as was anticipated, since in a number of instances those answering were of the opinion that it referred primarily to the operation of tight lock couplers and therefore many roads not using tight lock couplers did not express an opinion.

A total of 63 roads replied to the questionnaire; 34 of these roads expressed a preference, 10 for both sides and 24 for one side; the remaining 29 failed to indicate which method of operation was preferred, as it was their interpretation the questionnaire was intended for tight-lock couplers only.

Separating of Type E Couplers Because of Inverted or Missing Toggles

A member road has called attention to the committee's reference in the 1940 report to Standard E couplers separating on account of inverted or missing rotary lock-lift toggles. The report advocated discontinuing the use of the dowel-type lock-lift lever and toggle, substituting therefor the riveted type. It was the understanding at the time that the coupler manufacturers would discontinue furnishing the dowel type. In investigating the statement made by the member road that the dowel type rotary lock lifter and toggles were still being supplied, it developed that one coupler manufacturer, while not manufacturing any more of the dowel type lifters and toggles, was taking occasion to fill orders from stock already on hand. This subject was handled through the Coupler Manufacturers Mechanical Committee to the point that no further shipments will be made of the dowel type lifters and toggles.

Your committee has been advised that the Arbitration Committee will recommend a new paragraph to Sec. (c) of Interchange Rule 17, in which provision will be made for a repairing line to renew the old style bottom lock lifter or toggle, if defective, replacing them with either suitable parts in kind or with the two parts riveted together. In the latter case full charge may be made and scrap credit allowed for the old style parts removed. Your committee concurs in this recommendation of the Arbitration Committee.

Reclamation of Couplers

A study made by the Arbitration Committee in connection with coupler repairs developed that a large number of knuckles were being renewed for the purpose of bringing couplers within gage, whereas, the out-of-gage condition could have been corrected in a large percentage of such cases by renewing the knuckle lock only, thus reducing expenses to the car owner.

The Arbitration Committee has recommended for the consideration of the Coupler Committee a revision of Rule 18 (a-1). [See Arbitration Committee report.]

It is further recommended that the note accompanying Fig. D, Rule 18, Page 58 of the 1941 Code of Rules be changed from "Condemning limit for cracks horizontally inclined" to "Condemning limit for cracks extending in any direction."

Your committee accepts both recommendations as constructive changes which should be approved by the association and included in the Code of Rules.

Reclamation of Draft Keys—Limits for Wear

In connection with the practice of reclaiming draft keys as recommended in the 1940 report, request has come to your committee that further suggestions be made as to the wear limits within which the draft key reclamation might apply.

In the inquiry made regarding wear limits it developed that some roads have not encountered enough wear on the draft keys to give this subject serious consideration and little or no attention has been given either to wear limits or methods of reclamation. On other roads where the reclamation of draft keys has become a factor in car maintenance, it appears that the wear on the edge of the key is the governing factor in establishing the suitability of the key for reclamation. In other words, if the edge wear is within certain prescribed limits, the wear on the flat surface of the key will not be beyond the range of reclamation set up for edge wear. For this reason, it does not appear necessary to prescribe wear limits for key thickness.

The process of reclamation for draft keys as outlined in the 1940 report will take care of 3/8 in. wear in width at any cross section location. This limit may be applied to both 5-in. and 6-in. keys.

It is the suggestion of your committee that draft keys may be satisfactorily reclaimed if the maximum wear in width does not exceed 3/8 in. at any one point.

Elimination of Coupler-Yoke Filler Blocks

Your committee has been requested to support the recommendations of a local mechanical organization that provision be made for the elimination of filler blocks from the end of the coupler yokes, it being argued that frequently the blocks are missing, thus contributing to excessive slack in coupler attachments.

Your committee considers these filler blocks where used are serving a good purpose, as a protection against yoke or strap breakages and is further of the opinion if more attention was given to the maintenance of the blocks there would be fewer cases where they would be missing. For these reasons the committee does not approve the recommendation to discontinue the use of coupler yoke filler blocks.

Key Slots in Couplers

It has been the practice of some roads, in order to provide for vertical draft key attachments to the coupler shank, to burn a slot in the coupler shank between rivet holes. The ragged edges left by the burning of these slots form a ready origin for detail fractures. Applying localized heating to highly stressed parts, especially without annealing, is also conducive to development of fracture.

Your committee has been advised that the Arbitration Committee will include in its report a recommendation prohibiting this practice, and will make further provision that when couplers with burnt out key slots are removed for any reason, it will be at the expense of the owner.

The coupler committee concurs in this action taken by the Arbitration Committee.

Adding Filler Block in Head of Cast-Steel Yoke to Prevent Coupler Head from Drooping

Last year a member raised the question of adding filler block in the head of the cast-steel yoke to restrict the vertical movement of the coupler butt. Your committee has reviewed this matter and reports that the center line of the slot in the coupler butt is 1/8 in. above the slot in the yoke. Key slot in the center sill is on the center line of draft. With the tolerances provided, when the coupler and draft attachments are in place on the car they are all on the horizontal center line, with the vertical weight reaction on the key through the center sills.

In 1923 one of the coupler manufacturers cast yokes with this filler block for application to 1,000 cars. Investigation is going on to develop what, if any, beneficial results were obtained therefrom.

Your committee wishes to express its appreciation to the coupler manufacturers for the cooperative assistance rendered by the Mechanical Committee of the Coupler Manufactruers in the joint work carried on during the past year.

The report was signed by R. L. Kleine (chairman), assistant chief motive power-car, Pennsylvania; H. W. Coddington (vice-chairman), research and test engineer, N. & W.; E. E. Root, chief motive power, D. L. & W.; L. P. Michael, chief mechanical engineer, C. & N. W.; W. Bohnstengel, engineer of tests, A. T. & S. F., and H. W. Faus, engineer motive power, N. Y. C.

Exhibit A—Instructions Covering Adjustments to Improve the Anticreep Arrangement in Tight-Lock Couplers

The A. A. R. tight-lock couplers cast prior to January 1, 1939, were not correctly modified to improve the anticreep arrangement as approved by the Committee on Couplers and Draft Gears during March 1940.

The secondary anticreep in tight-lock couplers cast prior to January 1, 1939, consisted of a projection on the upper-guard-arm side of the lock that engaged a recess in the guard-arm wall of the bar. In service this recess would become filled with dirt, which interfered with proper functioning of the secondary anticreep. The length of the bottom lock hole from front to back was not important during this period, therefore careful attention was not given to control of this dimension.

The secondary anticreep in tight-lock couplers cast after January 1, 1939, consisted of a shoulder on the back of the toggle that engaged a ledge formed on the bottom rear wall of the lock hole. This change in the location of the secondary anticreep made it necessary to provide gages closely to control the length of the bottom lock hole.

When the changes to improve the anticreep arrangement, as approved during March, 1940, were made in tight-lock couplers cast prior to January 1, 1939, proper attention was not given to adjusting the length of these bottom lock holes. Investigations have shown that recent partings involving tight-lock couplers are largely the result of the bottom lock hole being too long, which permits an ineffective anticreep arrangement. Only couplers cast prior to January 1, 1939, have been involved in these recent partings.

The following sketches show correct and incorrect anticreep arrangement in tight-lock couplers. They illustrate how correct adjustments may be made and gages necessary to make correct adjustments.

Fig. 1 shows the tight-lock coupler anticreep arrangement with all parts in normal closed position and Fig. 2 shows the tight-lock coupler anticreep arrangement engaged to prevent upward movement of the lock. This illustrates the correct functioning of the anticreep arrangement when all parts are normal.

Fig. 3 shows the anticreep arrangement as it functions in a bar where the adjustments were made incorrectly. Note that

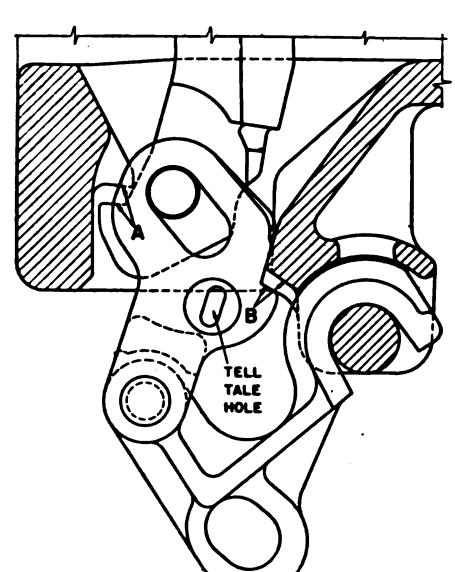


Fig. 1—Operating parts of the coupler in fully closed position

primary anticreep A is disengaged and secondary anticreep B is only partially engaged. If force is applied to lift the lock, the toggle tends to rotate about the secondary anticreep, thus rounding the corners of the toggle and bar. This action may also bend or spread the rotor lever.

Fig. 4 shows Gage No. 29875 correctly positioned on the bar, thus indicating that the adjustments to improve the anticreep arrangement were not made correctly in the bar. Note space between gage and bar at C and D.

Fig. 5 shows the same conditions as in Fig. 4 except with the anticreep adjustments made correctly to meet the requirements of gage No. 29875.

Method of Procedure

1—All tight-lock couplers having cast date prior to January 1, 1939, or serial number less than 1100, should be checked for effective anticreep arrangement. Use gage No. 29875 as shown in Fig. 4. It will be necessary to remove the knuckle and lock to make this check properly. The lock and toggle should also be checked for correctness using gage No. 1161 as described for Figure 8. (Figs. 6 to 8, incl., are not included in the present abstract of the committee's report are printed in the original report as submitted before the association.)

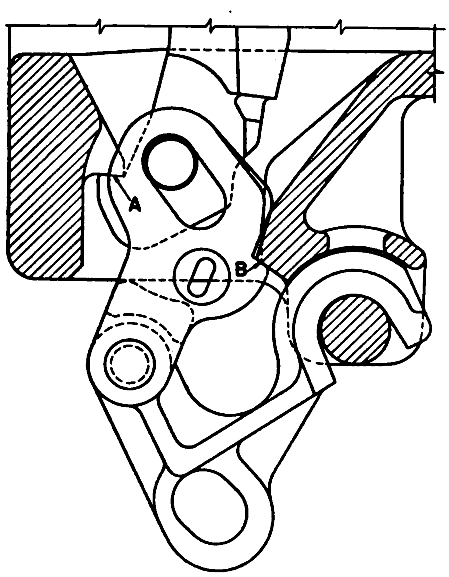


Fig. 2—Operating parts of the coupler with the primary and secondary anti-creep engaged

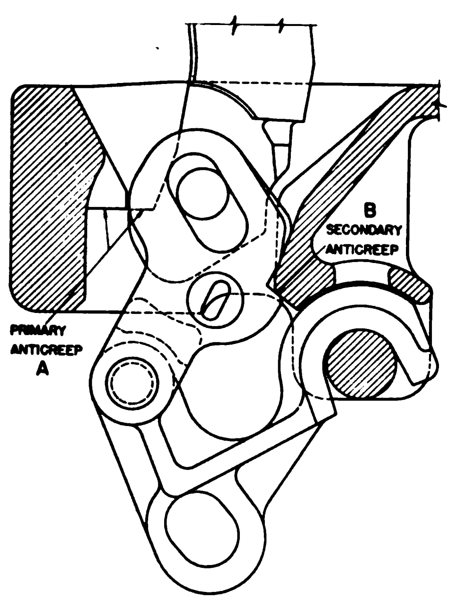


Fig. 3—Operating parts in anti-creep engaged position. Note the disengagement of the primary and the reduced overlap of secondary anti-creep due to incorrect modifications as in Fig. 4

2—Any couplers that do not check correctly (Item 1) should receive attention to improve the anticreep arrangement. It is recommended that couplers requiring further adjustment be removed from the car in order that the work may be properly performed and without haste or disturbance. This may be accomplished by having corrected couplers available to replace couplers removed so that the car may be returned to service.

3—Those couplers requiring further attention should have the secondary anticreep ledge rebuilt by electric welding, using gage No. 1160. The drawbar primary anticreep A should also be

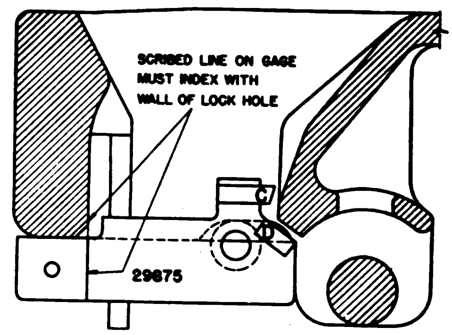


Fig. 4—Gage No. 29875 properly applied to incorrectly modified coupler as in Fig. 3—Clearance at C and D must be built up by welding as in Fig. 5

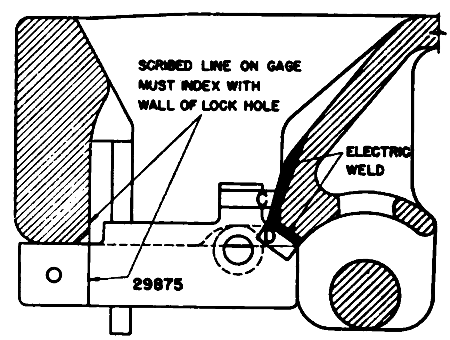


Fig. 5—Rear wall of the lock hole and secondary anti-creep shoulder corrected by electric welding to meet requirements of gage No. 29875

checked with gage No. 1160, Fig. 7, and any necessary adjustments made. Gage No. 29875 should be used to make a final check of these corrections as shown in Fig. 5. Any adjustments to the toggle or lock, as indicated by gage No. 1161, Fig. 8, should be made or the part replaced.

4—The coupler and parts should be reassembled and a final check made to determine the effectiveness of the anticreep arrangement. This may be done by inserting a chisel, or similar instrument, between the lock and knuckle-tail shelf and prying the lock upward while forcing the lock leg rearwardly. This check should show not less than 3/16 in. overlap at the primary anticreep A and 1/4 in. overlap at the secondary anticreep B, Fig. 2. If this final check is not satisfactory, all conditions should be rechecked and any necessary adjustments made.

5—The Brinell hardness number of the built-up surface should be approximately 160. Fleetweld No. 5, made by Lincoln Electric Company, Cleveland, Ohio, and Shurweld N, made by Hollup Corporation, Chicago, are satisfactory welding rods for this work.

6—When corrected couplers are reapplied to cars, they should be carefully checked for operation and any necessary adjustments should be made to insure free operation of the coupler. The A. A. R. approved type No. 3 tight-lock coupler operating arrangement is recommended.

Discussion

There was no discussion of that part of the report devoted to draft gears. At the invitation of the presiding officer, H. W.

Gilbert, chairman of the Coupler Manufacturers' Mechanical Committee, said that for many years since the adoption of the Type E coupler the committee has had close and pleasant relations with the Mechanical Division committee and attempted to do whatever was necessary to improve coupler performance. He referred to Mr. Cantley's study of coupler failures at low temperatures and said that this should develop some definitely helpful and useful information.

Mr. Gilbert said that the committee's report contains a clear description of the problem which has arisen in connection with tight-lock couplers and that the first attempt at corrections did not prove to be entirely satisfactory on account of the lack of proper adjustments. Mr. Gilbert stated that improvements in design, including machining, has enabled tight-lock couplers manufactured since 1939 to give satisfactory service, but further development and improvements are still being sought to be passed on to the Mechanical Division committee.

In response to a question, Chairman Kleine said that when difficulty is encountered due to the knuckle dropping on the bottom wall of the coupler, it is necessary only to apply a washer and raise the knuckle.

J. McMullen, superintendent car department, Erie, referred to the changes in Rule 18 and said that only a small percentage of couplers can be reclaimed by this method, the application of a properly conditioned knuckle being cheaper in the long run. He said that, at the suggestion of a member line which advised changing the lock rather than the knuckle, this method was tried on the Erie and they were not able to bring the pulling face of the knuckle within the gage limits.

E. B. Hall, chief mechanical officer, C. & N. W., said that there is need for a more positive lock, to avoid any possibility of couplers parting. Chairman Kleine replied that the committee feels keenly whenever there is an instance of coupler parting and that, without proper gages and gaging practice, this trouble is bound to occur occasionally. He said that the working surfaces of certain coupler parts must be machined to assure uniform results. With the present improved coupler and a more general knowledge of how to use the gages, he believes that the coupler problem is largely solved, although further improvements are still being studied.

K. F. Nystrom, mechanical assistant to executive vice-president, C. M. St. P. & P., said that the Milwaukee has no tight-lock couplers in service. He hoped that the committee would specify uncoupling from one side, which makes it more practicable to apply a locking device to the uncoupling lever handle. Mr. Nystrom said that he has accumulated from dismantled cars over 1,000 Type D couplers with 5-in. by 7-in. shanks, which he will use by the application of wrought- or cast-steel yokes in the interest of conservation of material.

The report was accepted and recommendations submitted to letter ballot.

Report on Locomotive Construction

Design of Fundamental Parts of Locomotives

Piston Ring Grooves for Lip Type Sectional Packing

The sub-committee was requested to prepare a proposed design of piston grooves that would take all types of lip type sectional packing rings now being manufactured; also, to look into the matter of standardizing grooves for snap type piston rings. It was decided that no consideration of standardizing grooves for snap type piston rings would be made as most railroads are changing to sectional rings on new piston applications.

Two designs of grooves for lip-type sectional rings were included in the report—one for the two-ring type, and one for a three-ring type. Grooves 1-in. wide by 1-in. deep were decided on for a standard and, while this size groove does not accommodate some of the rings now being manufactured, the sub-committee felt that manufacturers can change their rings to fit this size groove, and railroads can then use any make of lip type sectional packing without having to change pistons.

It was recommended that this be submitted to letter ballot for inclusion in the Manual as recommended practice.

Cylinder and Valve Head Studs

The sub-committee was requested to prepare a proposed design of studs to be used for holding cylinder heads and valve chamber heads.

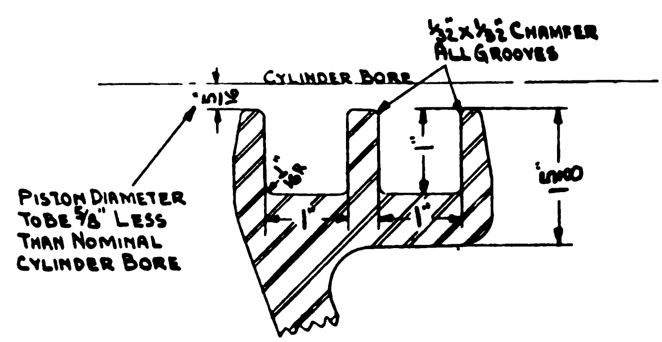
Designs included in the report are for new work, and for repairs to present cylinders where holes have become worn and an over-size stud is required in the cylinder end.

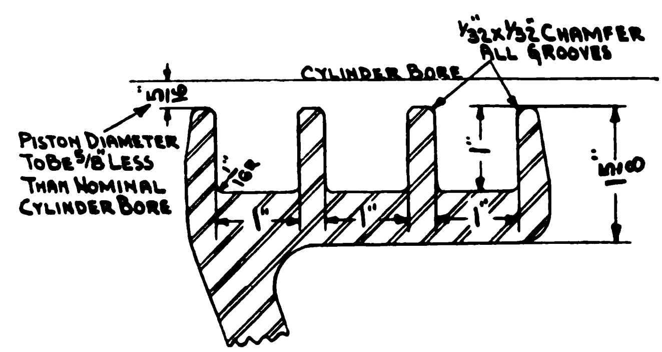
It was recommmended that this be submitted to letter ballot for inclusion in the Manual as recommended practice.

Screwed Pipe Fittings for 300 lb. Pressure Seamless Steel Couplings

The present standard coupling shown on Page L-139 of the Manual may be made of malleable iron or steel to A. A. R. Material Specification M-404, which prescribes a breaking test only, no chemical or physical requirements being shown. The design shown on Page L-139 is apparently based on the use of malleable iron, as the wall thicknesses are in general heavier than necessary for steel couplings.

In view of the extensive use of steel couplings the committee has prepared and now submits for approval as recommended practice, a design (a drawing of which was included in the report) which conforms to the standards of the American Petroleum Institute and which will weigh less and should cost less than steel couplings made to present A. A. R. standard dimensions.





Piston-ring grooves for lip type sectional packing

The material for these couplings is shown as seamless steel, to A. A. R. pipe specification M-111.

The adoption of this design will require a change in the title of the couplings shown on Page L-139 to read "Malleable Iron Coupling."

Fittings for Welding Iron or Steel Pipe on Locomotives

A table was included in the report of 32 replies to a questionnaire sent to a selected list of member roads and the locomotive builders, with respect to the welding of piping on locomotives

and the use of special welding fittings. Twenty-one of the 32 replies received reported that piping was welded as indicated in the table, but only four reported the use of any special welding fittings.

In view of the limited use as apparent from the replies received, and inasmuch as welding fittings can be readily obtained in the open market if desired, the sub-committee was of the opinion that it is not necessary to set up any standard for special welding fittings and so recommended.

Exhaust Steam Injectors and Exhaust Steam Feed Water Heaters

The sub-committee has continued its studies on the economies of various types of exhaust steam injectors and exhaust steam feedwater heaters for the purpose of determining more accurately the operating costs of these appurtenances.

In the previous analysis, the maintenance cost figures were in some cases reported inadequately and in others not given at all because the participating railroads did not detail their accounting records sufficiently to determine actual costs of specific parts repaired or renewed. To develop more accurate maintenance and repair costs, railroads having exhaust steam feedwater heaters and exhaust steam injectors in service, were asked to keep a record of all material and labor charges, for both classified and running repairs, for a period of six months, namely July 1 to December 31, 1940.

Such reports were received from 30 railroads for exhaust steam injectors and 53 railroads for exhaust steam feedwater heaters of all types.

The statements included in the report show the results of tabulated reports for labor and material costs on a dollar per mile basis for classified and for running repairs, and also a combined cost of labor and material and of classified and running repairs, i.e., a total operating cost for each type of equipment as reported. They are further separated to indicate maintenance and repair costs for the various types of injectors and heaters irrespective of age as compared with similar equipment as applied in the last five years, (1936 to 1940 inclusive). This differentiation was deemed advisable to show the difference in cost for maintaining injectors and heaters regardless of age and for maintaining injectors and heaters which are comparatively new or considered modern.

Development and Use of Oil-Electric Locomotives

This sub-committee has continued to assemble information as to the extended use of this type of equipment, and has brought up to date all information previously assembled by adding thereto units placed in service during the year 1940.

As of December 31, 1940, 1,111 units had been placed in operation since 1925, 362 of which, or 33.5 per cent, were placed in service during the year 1940. There were 157 units on order as of January 1, 1941, which exceeds considerably the number of units on order at the beginning of any previous year.

Prior to the year 1940 there were 44 units between 2,000 hp. to 6,000 hp. in service. During the year 1940, 49 additional such units were placed in service.

Table I indicates the rate of increase of Diesel-electric installations of varying horsepowers for the year 1940 as compared with units of the same horsepower placed in service prior to January 1, 1940:

Table 1—Trend of Diesel-Electric Locomotive Installations

Horsepower	Delivered 1940	Delivered prior to 1940	Per cent increase during 1940
Less than 300	1	25	4.0
300 to 600	60	131	45.8
600 to 900	155	367	42.3
900	...	80	...
950 to 2,000	97	102	95.0
2,000 to 6,000	49	44	111.0
Total	362	749	51.7

Table II shows that the number of Diesel units in freight service increased from 4 in 1939 to 20 as of December 31, 1940, and the total units in road passenger service increased from 69 to 118. In other words during the year 1940 the rate of increase of switchers kept pace with previous years, but the installation of Diesel-electric locomotives in road service exceeded any previous year.

In an attempt to determine the availability, lubricating and fuel oil performance, and cost of repairs as divided between electrical equipment and Diesel equipment, 138 railroads were requested to furnish information. Fifty-nine railroads advised that they did not operate Diesel locomotives, 30 railroads furnished information in time and in such form that it could be included in this report, and the remainder of the railroads did not report or the information was not furnished in the form requested.

Table II—Assignment of Diesel Locomotives in Service by Class of Service—As of December 31, 1940

	CLASS OF SERVICE			
Horsepower	Switch and Transfer	Road Freight	Road Passenger	Grand Total
Less than 300	26	..	..	26
300	120	..	..	120
310	1	..	..	1
320	1	..	..	1
340	6	..	..	6
350	7	..	..	7
360	13	..	..	13
380	16	..	..	16
400	8	..	1	9
460	3	..	..	3
500	5	[d]2	..	7
530	[a]7	..	..	7
550	1	..	..	1
600	426	1	4	431
640	1	..	..	1
650	1	..	..	1
660	73	7	..	80
720	1	..	..	1
750	..	1	..	1
800	6	..	1	7
900	[b]80	..	..	80
950	..	..	1	1
1000	[b]160	9	3	172
1100	2	..	..	2
1200	..	..	7	7
1330	..	..	[c]2	2
1500	2	..	..	2
1600	1	..	..	1
1800	2	..	10	12
2000	4	..	49	53
2100	..	..	1	1
2400	..	..	4	4
3000	..	..	2	2
3600	..	..	10	10
4000	..	..	16	16
5400	..	..	2	2
6000	..	..	5	5
Total	973	20	118	1,111

[a] One unit in combination switch and road freight service.
[b] Two units indicated as road-switchers.
[c] Used singly in passenger and in combination in freight service.
[d] Reported as freight and switch locomotives.

Tables III and IV show the details of operation for a six months period from July 1 to December 31, 1940 for switching and road locomotives, respectively. The report is assembled on the basis of unit costs per hour in the case of locomotives in switch and transfer service, and unit costs per mile for locomotives in road service. The information included covers only locomotives which had been placed in service prior to January 1, 1940, since low maintenance costs and high availability is expected from locomotives less than one year old. To have included such locomotives in the statement would not have reflected as accurately what might be expected in the way of average performance.

The committee emphasized that the lubrication, fuel, and maintenance costs shown in the table cover only a six months' test period and while considerable variation in the unit repair costs to locomotives of the same horepower and of approximately the same age may appear, this is due to the fact that in some cases the hours or miles operated during the test period were reduced on some locomotives on account of being held out of service for repairs, and at the same time there was an increase in the repair costs due to these repairs. This resulted in a high average cost for the test period, which, of course, will be reduced as additional miles are accumulated.

Standardization of Valves—Globe and Angle Valves for Steam Locomotives for 300 lb. Pressure

During the past year the committee has been studying the

Table III—Operating Cost of Diesel-Electric Switching Locomotives—Six-Month Period Ending December 31, 1940

Road Index	Placed in Service	Hours Prior to 7- 1-40	Hours Assigned Average per Month	Hours Operated Average per Month	Per Cent of Assignment Operated	Gallons Lubricating Oil Total	Gallons Lubricating Oil per Hour	Gallons Fuel Oil Total	Gallons Fuel Oil per Hour	Cost of Repairs Electrical Equipment Labor	Cost of Repairs Electrical Equipment Material	Cost of Repairs Diesel Equipment Labor	Cost of Repairs Diesel Equipment Material	Total (Diesel Electric Mechanical)	Repair Cost per Hour
300 HP															
26	4-18-27	67 186	735	706	96.00	265	.062	18 362	4.330	$ *----	$ *----	$ *----	$ *----	$ 740.00	$ .1746
26	10-19-26	70 687	558	531	95.00	85	.026	11 795	3.700	*----	*----	*----	*----	664.00	.2085
26	5- 2-26	64 434	454	317	70.00	88	.054	6 794	3.570	*----	*----	*----	*----	3 133.00	1.6472
39	-26	28 244	189	179	94.00	107	.100	1 395	1.300	*----	*----	*----	*----	220.99	.2061
67	1- 7-32	60 766	736	661	89.90	294	.074	14 296	3.600	*----	*----	*----	*----	619.76	.1561
67	7-23-31	64 951	736	450	61.90	360	.133	9 609	3.560	*----	*----	*----	*----	3 164.98	1.1722
67	8-29-31	53 379	736	487	66.10	130	.044	9 163	3.140	*----	*----	*----	*----	1 310.43	.4485
67	1- 2-26	39 759	736	406	55.10	305	.125	9 770	4.010	*----	*----	*----	*----	1 592.16	.6536
67	1-22-32	47 979	736	418	56.80	400	.159	9 807	3.910	*----	*----	*----	*----	1 898.93	.7568
138	*----	*----	736	516	70.00	342	.110	5 300	1.710	*----	*----	*----	*----	608.00	.1966
TOTAL		497 385	6 352	4 671		2 376		96 291		$ ----	$ ----	$ ----	$ ----	$ 13 952.25	
Average		55 265	635	467	73.55	238	.0849	9 629	3.4352	----	----	----	----	1 395.23	$ .1978
600 HP															
6	2- -35	35 654	736	512	70.00	569	.185	20 222	6.600	$ *----	$ *----	$ *----	$ *----	$ 1 738.16	$ .5658
6	6- -37	31 554	736	563	76.00	556	.164	26 095	7.700	*----	*----	*----	*----	2 247.28	.6653
6	8- -37	22 257	736	566	77.00	463	.136	24 547	7.200	*----	*----	*----	*----	1 662.41	.4898
6	6- -36	29 014	736	551	75.00	531	.160	19 797	6.000	*----	*----	*----	*----	2 922.77	.8835
6	7- -37	23 145	736	495	67.00	525	.179	11 359	3.800	*----	*----	*----	*----	1 525.62	.5142
6	7- -37	23 087	736	713	97.00	555	.129	23 092	5.400	*----	*----	*----	*----	371.98	.0870
6	7- -37	19 727	736	686	93.00	530	.128	15 688	3.800	*----	*----	*----	*----	1 495.64	.3631
15	12- 8-36	23 605	659	659	100.00	379	.096	21 218	5.360	*----	*----	*----	*----	198.00	.0500
17	10- -35	33 104	602	602	100.00	393	.108	18 444	5.106	199.08	22.85	517.36	70.82	810.00	.2242
17	5- -35	36 321	602	602	100.00	391	.108	22 599	6.264	258.87	25.40	496.49	56.43	837.19	.2320
17	6- -34	37 613	593	593	100.00	507	.144	35 258	9.906	353.44	65.17	663.43	175.74	1 257.78	.3535
17	6- -34	44 850	591	591	100.00	395	.108	20 504	5.770	240.59	29.62	775.22	703.30	1 748.73	.4927
24	10- 2-37	22 269	679	677	99.60	518	.127	22 882	5.640	80.23	14.56	362.08	391.89	1 024.23	.2523
24	10- 2-37	22 513	697	676	99	562	.139	22 650	5.580	91.31	37.15	348.31	661.31	1 308.83	.3227
24	10- 2-37	22 343	697	676	96.70	721	.178	22 506	5.550	94.49	9.55	348.33	648.70	1 401.06	.3453
24	6-22-39	8 515	720	717	99.60	443	.103	17 099	3.970	72.61	206.84	263.91	320.99	864.35	.2008
24	6-22-39	8 586	727	694	96.00	481	.116	21 640	5.200	65.42	57.58	613.70	397.44	1 135.80	.2730
24	6-22-39	8 197	720	714	99.10	481	.112	21 489	5.010	70.98	64.10	473.58	200.81	809.40	.1888
26	8-20-30	62 378	657	475	72.00	374	.131	19 784	6.940	*----	*----	*----	*----	2 659.00	.9320
26	1-14-39	10 795	664	621	94.00	518	.138	18 783	5.040	*----	*----	*----	*----	1 257.00	.3373
28	1- -38	19 869	736	577	96.70	413	.119	15 226	4.400	*----	*----	*----	*----	2 555.00	.7382
28	1- -38	20 302	736	696	94.00	462	.111	18 233	4.360	*----	*----	*----	*----	794.00	.1901
28	1- -38	19 527	736	594	71.00	430	.121	23 319	6.540	*----	*----	*----	*----	1 211.00	.3397
32	8- 8-39	6 934	736	613	83.00	390	.106	21 032	5.720	137.78	67.03	809.44	274.86	1 289.11	.3505
34	9- 6-32	54 033	734	584	79.00	509	.145	21 400	6.100	235.28	145.72	690.93	537.84	1 609.77	.4593
34	5- 5-38	16 912	734	702	95.70	533	.126	13 821	3.280	186.89	212.93	575.98	264.35	1 240.15	.2943
34	5- 9-38	16 216	731	651	89.00	354	.091	13 717	3.510	189.01	20.45	485.91	272.88	968.25	.2481
34	5-22-39	6 662	587	570	97.00	430	.126	12 902	3.770	183.13	66.30	279.22	477.24	1 105.89	.3232
36	8- 8-36	32 159	736	700	95.00	538	.130	19 705	4.700	*----	*----	*----	*----	1 714.00	.4083
36	8- 5-36	31 116	690	684	99.20	455	.110	21 560	5.200	*----	*----	*----	*----	1 833.00	.4464
36	8- 4-36	31 032	698	692	99.00	426	.100	21 611	5.200	*----	*----	*----	*----	1 495.00	.3602
48	9-28-37	21 527	528	515	97.63	314	.101	20 528	6.630	193.80	30.35	239.85	28.23	816.25	.2640
48	1-20-37	26 157	693	683	98.53	497	.121	14 989	3.650	141.79	39.51	331.01	398.69	1 079.05	.2631
48	1- 4-37	27 656	711	679	95.61	658	.161	20 841	5.110	357.65	108.02	267.47	361.47	2 174.41	.5333
48	12-31-36	26 466	684	599	87.51	560	.156	18 540	4.850	371.56	46.08	864.89	959.46	2 522.62	.7017
48	12-30-36	27,777	619	608	98.25	419	.113	17,780	4.870	$ 164.57	$ 9.53	$ 295.16	$ 148.58	$ 914.13	$ .2505
48	12-28-36	26,826	712	654	91.92	583	.168	15,807	4.020	228.06	180.37	314.10	251.89	1,306.61	.3327
48	12-28-36	25,678	697	685	98.33	702	.171	19,858	4.820	178.50	20.66	334.74	160.14	946.33	.2301
49	12-26-39	24,906	736	688	93.43	594	.144	26,121	6.330	91.63	67.95	232.72	251.76	820.44	.1988
54	2-11-39	11,531	736	696	94.60	535	.128	22,170	5.310	*----	*----	*----	*----	2,245.12	.5374
54	2- 8-39	11,436	736	642	87.20	268	.070	16,463	4.270	*----	*----	*----	*----	1,555.34	.4037
63	1-31-40	2,871	614	582	94.80	328	.094	23,357	6.680	179.00	64.00	318.00	368.00	2,672.00	.7647
63	12-29-39	6,183	726	666	91.80	395	.096	22,269	5.560	177.00	588.00	415.00	407.00	1,992.00	.4981
63	12-29-39	4,230	731	696	95.30	420	.102	22,017	5.270	128.00	242.00	274.00	214.00	968.00	.2318
63	12-30-39	399	604	553	91.50	396	.120	21,233	6.390	183.00	62.00	425.00	462.00	1,362.00	.4102
67	12-22-38	12,156	736	671	91.10	263	.065	14,174	3.520	*----	*----	*----	*----	1,134.60	.2819
67	11-14-38	13,561	736	690	93.80	340	.072	16,498	3.980	*----	*----	*----	*----	1,062.97	.2560
67	11-14-38	13,167	736	669	91.00	287	.071	15,889	3.950	*----	*----	*----	*----	578.54	.1440
67	8- 2-38	13,631	736	543	73.70	425	.130	18,987	5.830	*----	*----	*----	*----	3,670.22	1.1269
67	9- 1-37	21,532	736	692	94.00	505	.121	19,998	4.820	*----	*----	*----	*----	521.55	.1256
67	1- 9-33	49,046	736	546	74.10	400	.122	21,309	6.510	*----	*----	*----	*----	1,246.99	.3808
71	7-12-37	21,311	584	577	98.80	293	.084	12,899	3.720	102.00	58.00	301.00	387.00	1,080.00	.3118
71	7-13-37	21,631	584	562	96.20	372	.108	16,033	4.750	114.00	39.00	467.00	289.00	1,078.00	.3200
71	7-13-37	22,089	616	601	97.50	258	.072	16,449	4.560	106.00	298.00	370.00	557.00	1,676.00	.4650
71	7-13-37	20,146	530	530	100.00	300	.096	16,026	5.050	47.00	42.00	63.00	689.00	946.00	.2982
71	9-11-39	6,031	574	556	97.00	195	.090	12,118	5.440	98.00	7.00	295.00	131.00	641.00	.1920
71	9-11-39	5,571	664	630	94.70	267	.072	17,360	4.600	159.00	28.00	587.00	219.00	1,175.00	.3114
74	9-30-39	6,085	736	658	89.30	346	.087	20,600	5.200	*----	*----	*----	*----	1,902.27	.4823
75	9- -38	14,209	736	615	83.50	1,047	.280	23,666	6.420	*----	*----	269.00	2,730.00	2,999.00	.8130
75	3- -38	16,410	510	510	100.00	549	.150	14,505	4.730	*----	*----	3,977.00	2,082.00	6,059.00	1.9781
85	4-15-38	15,246	646	641	99.10	329	.090	22,606	5.090	137.95	18.44	283.71	34.12	694.99	.1808
85	3-12-38	16,717	653	649	99.40	325	.080	22,308	5.700	136.40	29.93	246.47	14.16	578.17	.1485
85	3-13-38	15,928	669	667	99.80	285	.070	24,224	6.000	172.43	21.84	240.76	26.59	703.55	.1757
85	3- 7-38	16,257	669	664	99.30	151	.040	23,223	5.800	119.58	29.34	249.25	33.31	560.51	.1408
85	10-30-36	23,306	660	653	98.90	964	.250	19,375	4.900	306.90	70.97	519.38	107.43	1,289.08	.3291
85	4-19-38	15,592	609	604	99.00	60	.020	22,589	6.200	228.45	31.76	297.80	22.13	744.22	.2055
85	10-23-36	19,861	676	638	94.30	548	.140	20,981	5.500	176.80	100.83	648.23	67.94	1,344.61	.3513
99	7-17-39	7,747	736	654	88.80	433	.110	17,514	4.470	183.14	64.55	487.65	247.42	1,007.16	.2568
100	4-20-36	32,244	657	564	85.60	318	.094	25,892	7.660	270.71	85.51	111.41	1,175.87	4,477.33	1.3247
113	1-13-40	3,641	736	631	85.85	117	.031	23,798	6.270	405.22	65.53	143.00	66.62	1,028.16	.2712
113	1-13-40	3,862	736	659	89.56	218	.055	27,808	7.030	231.31	50.06	225.14	174.11	949.01	.2400
113	9- 1-39	6,102	736	670	91.53	234	.058	24,687	6.100	148.88	19.52	130.17	12.31	491.23	.1221
113	12-13-39	4,114	736	634	86.23	277	.073	13,816	3.620	238.61	2.46	352.85	97.81	941.40	.2472
113	12-18-39	3,809	736	608	82.61	465	.127	13,389	3.670	155.76	61.18	478.22	307.11	1,203.48	.3299
113	11-29-39	3,922	736	617	83.88	312	.084	15,645	4.220	198.02	65.55	334.95	796.28	1,733.61	.4680
113	11-28-39	4,054	736	595	80.89	279	.078	15,980	4.470	192.34	53.51	409.08	[a]184.67	737.73	.2065
113	12- 1-39	4,233	736	589	80.14	230	.065	13,902	3.920	291.02	152.00	518.30	[a]495.25	785.50	.2220
113	3- 6-39	8,764	736	615	83.61	309	.084	15,439	4.180	116.19	95.11	259.85	[a]635.29	312.97	.0848
123	1-28-39	11,555	736	700	95.00	380	.090	18,943	4.500	*----	*----	*----	*----	809.51	.1928
138	*----	*----	736	673	91.40	225	.056	30,997	7.670	*----	*----	*----	*----	1,108.20	.2746
138	*----	*----	736	618	83.94	292	.078	24,757	6.680	*----	*----	*----	*----	2,172.45	.5860
138	*----	*----	736	690	93.70	449	.108	22,654	5.480	*----	*----	*----	*----	1,374.95	.3322
138	*----	*----	736	681	92.50	491	.121	24,908	6.120	*----	*----	*----	*----	2,047.30	.5012
TOTAL		1,497,462	57,372	52,160		35,039		1,651,901		$9,189.39	$3,993.81	$24,281.05	$18,332.28	$117,330.96	
Average		18,955	691	628	90.93	422	.1119	19,902	5.2776	180.18	78.31	476.10	359.46	1,413.63	$ .3749

NOTES.- *Information not available.

[a]Credit.

Table III—Operating Cost of Diesel-Electric Switching Locomotives—Six-Month Period Ending December 31, 1940—Continued

Road Index	Placed in Service	Hours Prior to 7-1-40	Hours Assigned Average per Month	Hours Operated Average per Month	Per Cent of Assignment Operated	Gallons Lubricating Oil Total	Gallons Lubricating Oil per Hour	Gallons Fuel Oil Total	Gallons Fuel Oil per Hour	Cost of Repairs: Electrical Equipment Labor	Cost of Repairs: Electrical Equipment Material	Cost of Repairs: Diesel Equipment Labor	Cost of Repairs: Diesel Equipment Material	Total (Diesel Electric Mechanical)	Repair Cost per Hour
660 HP															
66	9-26-39	6 271	701	631	90.00	435	.1145	19 650	5.176	$ 95.70	$ 21.20	$ 265.32	$ 216.62	$ 820.28	$ .2167
66	9-28-39	5 496	684	612	89.00	254	.0691	14 007	3.812	129.79	105.32	259.26	78.17	781.82	.2127
75	9- -39	5 291	566	566	100.00	450	.1300	27 324	8.050	*----	*----	*----	*----	1 420.00	.4181
85	11-13-36	24 542	677	663	97.90	466	.1200	20 520	5.200	299.48	91.34	446.58	176.15	1 272.55	.3200
126	12- 6-39	4 907	736	696	94.60	503	.1205	25 278	6.053	199.08	122.96	629.62	196.69	1 149.29	.2752
TOTAL		46 507	3 364	3 168		2 108		106 779		$ 724.05	$ 340.82	$ 1 600.78	$ 667.63	$ 5 443.94	
Average		9 301	673	634	94.18	422	.1110	21 356	5.6170	181.01	85.21	400.20	166.91	1 088.79	$ .2864
900 HP															
6	9- -37	22 323	736	624	85.00	743	.198	18 189	4.900	$ *----	$ *----	$ *----	$ *----	$ 2 304.18	$ .6156
6	9- -37	20 872	736	611	83.00	870	.255	21 683	5.900	*----	*----	*----	*----	2 253.69	.6143
6	9- -37	21 785	736	647	88.00	514	.132	18 635	4.800	*----	*----	*----	*----	1 020.14	.2629
24	11-28-37	19 468	697	619	88.80	1 523	.410	30 394	8.180	150.91	19.51	383.11	1 562.15	3 583.58	.9649
24	12- 5-37	19 574	684	664	97.10	915	.229	33 302	8.350	95.60	35.05	461.86	389.73	1 405.58	.3525
26	1-14-39	11 085	706	660	93.00	160	.242	24 047	6.070	*----	*----	*----	*----	964.00	.2436
48	11- 6-37	20 884	703	631	89.71	620	.163	22 085	5.540	588.14	113.28	774.44	1 316.44	4 144.50	1.0953
48	11- 6-37	21 465	660	646	97.78	786	.203	25 968	6.700	332.03	30.25	394.67	711.25	1 709.58	.4414
48	11-26-37	20 517	544	470	86.37	404	.143	20 711	6.340	456.81	76.67	665.04	664.88	3 373.90	1.1960
54	1-10-38	15 136	736	693	94.15	1 246	.300	29 512	7.100	*----	*----	*----	*----	2 266.47	.5451
54	1-10-38	19 593	736	636	86.40	1 510	.396	29 798	7.810	*----	*----	*----	*----	4 163.32	1.0907
67	12-20-37	21 250	736	638	86.60	647	.169	23 179	6.060	*----	*----	*----	*----	2 790.57	.7292
67	12-20-37	21 195	736	689	93.50	855	.206	30 734	7.438	*----	*----	*----	*----	1 562.06	.3780
67	5-23-38	16 028	736	562	76.30	763	.226	17 785	5.270	*----	*----	*----	*----	2 614.74	.7752
67	5-23-38	16 137	736	676	91.80	918	.226	22 002	5.420	*----	*----	*----	*----	779.20	.1921
67	4-22-38	16 959	736	716	97.30	743	.172	22 605	5.260	*----	*----	*----	*----	324.86	.0756
67	4-22-38	15 771	736	536	72.80	614	.190	17 861	5.550	*----	*----	*----	*----	2 478.03	.7698
71	8- 3-37	22 252	596	560	94.00	442	.132	22 876	6.800	168.00	92.00	684.00	1 222.00	2 505.00	.7449
71	8- 3-37	22 226	680	650	95.60	436	.114	30 386	7.790	100.00	10.00	542.00	1 531.00	2 427.00	.6223
71	5- 2-39	4 094	373	345	92.50	550	.266	28 816	13.914	144.00	293.00	735.00	986.00	3 111.00	1.5022
71	5-25-39	3 888	336	328	97.60	631	.321	28 789	14.643	118.00	60.00	684.00	1 161.00	3 406.00	1.7325
74	12-16-38	12 215	736	664	90.30	395	.099	24 558	6.200	*----	*----	*----	*----	1 285.76	.3226
74	12-27-38	10 251	736	651	88.30	850	.217	24 039	6.200	*----	*----	*----	*----	1 340.88	.3437
74	12-27-38	10 300	736	645	87.70	930	.240	23 841	6.200	*----	*----	*----	*----	1 357.51	.3506
75	8- -38	12 245	440	440	100.00	765	.290	18 335	6.940	*----	*----	1 754.00	3 596.00	5 350.00	2.0257
75	6- -38	15 403	616	527	85.50	591	.160	20 234	5.470	*----	*----	2 965.00	3 213.00	6 178.00	1.9538
TOTAL		443 331	17 859	15 943		20 068		645 053		$2 415.38	$ 796.13	$10 717.86	$17 708.32	$ 68 554.82	
Average		16 419	661	590	89.27	743	.2097	23 891	6.7432	241.54	79.61	893.15	1 475.69	2 539.06	$ .7166
1000 HP															
6	12- -39	4 304	736	662	90.00	589	.148	29 411	7.400	$ *----	$ *----	$ *----	$ *----	$ 1 012.67	$ .2548
6	12- -39	4 066	736	708	96.00	600	.141	29 454	6.900	*----	*----	*----	*----	595.54	.1402
6	11- -39	4 428	736	632	86.00	577	.152	23 718	5.400	*----	*----	*----	*----	690.69	.1820
6	6- -39	8 496	736	682	93.00	147	.035	26 625	6.500	*----	*----	*----	*----	642.33	.1570
6	6- -39	8 402	736	570	77.00	166	.048	25 195	7.300	*----	*----	*----	*----	649.74	.1899
6	6- -39	8 199	736	706	96.00	124	.029	32 026	7.600	*----	*----	*----	*----	411,26	.0972
6	6- -39	8 564	736	675	92.00	162	.040	25 070	6.200	*----	*----	*----	*----	402.49	.0995
6	6- -39	8 170	736	696	95.00	155	.037	28 845	6.900	*----	*----	*----	*----	323.75	.0775
6	6- -39	8 906	736	697	95.00	142	.033	29 560	7.100	*----	*----	*----	*----	661.68	.1583
6	7- -39	6 637	736	634	87.00	601	.182	22 014	5.700	*----	*----	*----	*----	940.77	.2474
6	7- -39	7 198	736	661	90.00	709	.173	23 944	6.000	*----	*----	*----	*----	1 124.66	.2835
6	8- -39	7 347	736	657	89.00	968	.246	24 420	6.200	*----	*----	*----	*----	1 666.72	.4227
6	8- -39	5 914	736	717	98.00	596	.138	27 573	6.400	*----	*----	*----	*----	570.52	.1327
6	8- -39	6 540	736	639	87.00	868	.226	26 226	6.800	*----	*----	*----	*----	1 174.36	.3062
6	8- -39	7 346	736	622	85.00	710	.190	24 395	6.500	*----	*----	*----	*----	858.90	.2302
49	10- 3-37	19 154	736	654	88.84	1 577	.402	30 722	7.830	120.10	122.08	297.41	670.72	1 440.66	.3672
54	8-10-39	7 344	736	684	92.98	655	.160	28 280	6.890	*----	*----	*----	*----	2 090.05	.5090
54	8-25-39	6 820	736	685	93.09	921	.224	28 698	6.980	*----	*----	*----	*----	1 873.40	.4557
54	7-12-39	6 946	562	528	94.07	250	.079	20 552	6.480	*----	*----	*----	*----	1 204.28	.3799
54	4-29-39	9 540	736	718	97.55	1 003	1.003	32 250	7.490	*----	*----	*----	*----	1 400.69	.3251
54	4-29-39	9 299	736	696	94.57	399	.096	28 939	6.930	*----	*----	*----	*----	1 359.48	.3255
54	3-29-39	1 458	736	670	91.06	1 497	.372	32 562	8.100	*----	*----	*----	*----	2 832.97	.7045
65	6- 2-39	8 832	736	658	89.40	663	.168	27 394	6.940	*----	*----	*----	*----	1 097.79	.2782
71	9-25-39	6 077	684	624	91.20	440	.114	25 973	6.930	208.00	77.00	687.00	877.00	2 058.00	.5497
71	11-17-39	4 493	718	665	92.60	493	.120	30 022	7.520	172.00	65.00	797.00	116.00	1 375.00	.3448
71	9-13-39	6 078	713	694	97.30	280	.066	32 783	7.870	180.00	[a]39.00	448.00	127.00	925.00	.2222
74	10-10-39	6 193	736	725	98.60	614	.141	27 993	6.400	*----	*----	400.46	365.66	766.12	.1760
74	10- 4-39	6 329	736	720	97.90	490	.113	27 674	6.400	*----	*----	612.33	542.99	1 155.32	.2672
75	6- -39	7 631	546	546	100.00	546	.170	29 546	9.030	*----	*----	1 521.00	1 615.00	3 136.00	.9584
75	5- -39	6 040	503	503	100.00	524	.170	30 365	10.650	*----	*----	445.00	703.00	1 148.00	.3805
111	*----	*----	596	578	97.00	427	.123	35 170	10.140	*----	*----	*----	*----	723.04	.2084
TOTAL		216 751	21 983	20 306		17 893		867 399		$ 680.10	$ 225.08	$ 5 208.20	$ 5 012.37	$ 36 311.88	
Average		7 225	709	655	92.36	577	.1468	27 981	7.1198	170.02	56.27	651.03	626.55	1 171.35	$ .2981

NOTES.- *Information not available. [a]Credit.

design and construction of the standard globe and angle valves with a view to incorporating any changes which it is felt would improve the serviceabilty, and at the present time has the following recommendation to make.

Fit Between Disc and Stem

To provide for closer tolerances on the fit between disc and stem in order to avoid any excessive looseness, and between body and bonnet, certain changes in dimensions of these parts have been made, which are included on revised pages F-155, 157, 159, 161, 165, 167 and 169 of the Manual now submitted for approval. These changes will reduce the clearances between stem and disc nut, end of stem and bottom of disc, and body and bonnet, and will effectively improve the fit of the bonnet, stem and disc assembly.

The committee is studying certain other changes but is not prepared to report further at this time.

Roller Bearings for Steam Locomotives and Tenders

The sub-committee has continued to assemble information as to roller bearing applications to steam locomotives and tenders during 1940, and has obtained further information and experiences from roads using such bearings.

[The report included, in addition to the data on applications shown in Table V, a detailed tabulation of bearing service

Table IV—Operating Cost of Diesel-Electric Road Locomotives—Six-Month Period Ending December 31, 1940

Road Index	Placed in Service	Miles Prior to 7-1-40	Miles Assigned Average per Month	Miles Operated Average per Month	Per Cent of Assignment Operated	Gallons Lubricating Oil Total	Gallons Lubricating Oil per Mile	Gallons Fuel Oil Total	Gallons Fuel Oil per Mile	Cost of Repairs Electrical Equipment Labor	Cost of Repairs Electrical Equipment Material	Cost of Repairs Diesel Equipment Labor	Cost of Repairs Diesel Equipment Material	Total (Diesel Electric Mechanical)	Repair Cost per Mile
600 HP															
49	6-11-35	1 184 551	17 357	17 212	99.16	1 267	.0123	49 913	.4833	$ 327.02	$ 322.92	$ 1 216.30	$ 1 594.24	$ 5 895.56	$.0571
49	7- 1-40	1 209 817	17 357	17 236	99.30	1 146	.0111	48 806	.4719	711.50	1 052.16	2 205.70	1 937.83	8 166.14	.0790
TOTAL		2 394 368	34 714	34 448		2 413		98 719		$ 1 038.52	$ 1 375.08	$ 3 422.00	$ 3 532.07	$ 14 061.70	
Average		1 197 184	17 357	17 224	99.23	1 207	.0117	49 360	.4776	519.26	687.54	1 711.00	1 766.04	7 030.85	$.0680
660 HP															
52	12- -37	386 653	12 178	11 984	98.41	843	.0117	38 531	.5359	$ 87.17	$ 290.57	$ 2 149.88	$ 444.54	$ 4 255.24	$.0588
52	6- -35	823 506	14 760	14 743	99.88	1 042	.0118	52 546	.5941	362.71	139.42	2 094.79	1 766.04	7 123.06	.0805
52	6- -35	807 718	14 585	14 518	99.54	1 350	.0155	52 209	.5994	366.54	508.73	2 041.19	355.86	5 011.49	.0575
TOTAL		2 017 877	41 523	41 245		3 235		143 286		$ 816.42	$ 938.72	$ 6 285.86	$ 2 511.38	$ 16 359.79	
Average		672 626	13 841	13 748	99.33	1 078	.0131	47 762	.5790	272.14	312.91	2 095.29	837.13	5 453.26	$.0661
1000 HP															
54	11-28-39	92 861	3 220	3 040	94.40	615	.0336	49 791	2.7300	$ *----	$ *----	$ *----	$ *----	$ 7 664.38	$.4202
54	11-29-39	54 452	2 248	1 777	79.04	984	.0910	42 964	4.0300	*----	*----	*----	*----	5 493.99	.5154
TOTAL		147 313	5 468	4 817		1 599		92 755		$ ----	$ ----	$ ----	$ ----	$ 13 158.37	
Average		73 657	2 734	2 408	88.09	800	.0554	46 378	3.2096	----	----	----	----	6 579.19	$.4553
1800 HP															
6	6- -37	717 243	21 497	21 497	100.00	3 449	.0240	154 824	1.2000	$ 1 229.06	$ 803.35	$ 2 151.38	$ 1 488.66	$ 5 396.96	$.0418
6	6- -37	699 594	21 951	21 951	100.00	3 591	.0270	152 560	1.1500	1 336.07	1 368.42	2 440.11	4 286.82	11 854.78	.0900
6	1- -38	563 262	18 177	18 177	100.00	2 597	.0230	138 770	1.2330	1 484.56	1 507.27	2 109.65	1 346.49	8 612.88	.0790
6	1- -38	555 641	22 065	22 065	100.00	2 540	.0190	160 465	1.2120	1 217.42	1 304.66	2 137.99	1 951.65	8 882.09	.0671
6	3- -38	145 362	24 227	24 227	100.00	2 812	.0190	170 825	1.1750	1 183.59	1 076.94	2 359.96	4 420.92	12 021.13	.0827
6	3- -38	566 686	20 758	20 758	100.00	2 930	.0230	145 574	1.1680	1 141.22	1 754.95	2 218.89	4 739.34	12 893.63	.1035
24	10-21-36	1 283 662	31 470	31 010	98.50	2 917	.0160	175 672	.9500	644.65	303.59	3 758.86	6 654.70	13 477.04	.0724
24	11- 3-36	1 309 189	31 566	31 220	98.90	2 756	.0150	177 820	.9500	588.09	274.34	3 612.56	6 030.16	12 249.16	.0654
24	11-20-36	1 074 064	25 473	25 473	100.00	2 592	.0170	163 167	1.0700	706.75	2 285.29	2 332.42	2 720.45	11 314.21	.0740
24	12- 4-36	1 056 527	25 798	25 798	100.00	2 569	.0170	162 542	1.0500	646.53	1 266.63	2 561.18	1 896.80	10 744.81	.0694
TOTAL		7 971 230	242 982	242 176		28 453		1 602 219		$10 177.94	$11 945.44	$25 683.00	$35 535.99	$107 446.69	
Average		797 123	24 298	24 218	99.67	2 845	.0196	160 222	1.1027	1 017.79	1 194.54	2 568.30	3 553.60	10 744.67	$.0739
2000 HP															
6	9- -39	196 275	24 589	24 589	100.00	3 512	.0240	235 701	1.5970	$ 1 888.41	$ 132.94	$ 4 319.41	$ 5 815.84	$ 14 967.19	$.1014
6	9- -39	184 917	24 147	24 147	100.00	2 730	.0190	189 192	1.3050	1 467.99	908.59	2 603.06	1 813.33	9 177.23	.0633
51	12- -39	156 273	22 485	21 746	96.70	2 000	.0150	202 452	1.5500	697.68	1 209.08	2 547.92	6 945.19	18 558.53	.1422
51	12- -39	145 951	20 683	20 273	98.00	2 610	.0210	239 598	1.9700	1 658.88	758.66	1 775.20	1 466.51	15 372.23	.1264
71	10-25-39	53 847	14 658	14 519	99.10	1 441	.0170	150 689	1.7300	961.00	430.00	2 070.00	2 582.00	8 985.00	.1031
71	10-24-39	54 014	14 658	14 658	100.00	1 529	.0170	145 512	1.6500	1 034.00	412.00	1 715.00	920.00	6 600.00	.0750
TOTAL		791 277	121 220	119 932		13 822		1 163 144		$ 7 707.93	$ 3 851.27	$15 030.59	$19 542.87	$ 73 660.18	
Average		131 879	20 203	19 989	98.94	2 304	.0192	193 857	1.6164	1 284.66	641.88	2 505.10	3 257.15	12 276.69	$.1024
3600 HP															
1	8-35 & 10-40	772 827	*----	13 125	----	3 982	.0510	131 938	1.6500	$ *----	$ *----	$ *----	$ *----	$ 28 307.00	$.3595
130	6-19-39	564 288	34 646	34 347	100.00	19 481	.0940	491 684	2.3860	8 210.10	14 809.99	15 569.44	39 441.43	112 057.87	.5438
TOTAL		1 337 115		47 472		23 463		623 622						$140 364.87	
Average		668 558		23 736		11 732	.0824	311 811	2.1895					70 182.44	$.4928
4000 HP															
26	6- 1-39	290 198	25 904	25 904	100.00	4 416	.028	444 644	2.861	$ 640.00	$ 945.00	$ 3 396.00	$ 8 775.00	$ 23 837.00	$.1534
26	6- 1-39	288 327	25 645	25 645	100.00	5 142	.033	462 572	3.000	832.00	1 848.00	5 417.00	15 601.00	28 169.00	.1831
130	3- -39	257 862	18 110	18 110	100.00	5 924	.055	250 402	2.305	1 071.94	7 226.54	5 133.13	10 651.44	32 939.40	.3031
TOTAL		836 387	69 659	69 659		15 482		1 157 618		$ 2 543.94	$10 019.54	$13 946.13	$35 027.44	$ 84 945.40	
Average		278 796	23 220	23 220	100.00	5 161	.0370	385 873	2.7697	847.98	3 339.84	4 648.71	11 675.81	28 315.13	$.2032

NOTE.- *Information not available.

records showing mileages made by different types of roller bearings, the number and cause of bearing failures and the mileage per failure. The report also included a tabulation of bearing maintenance costs, bearing mileages between failures and axle failures.—EDITOR]

The sub-committee on roller bearings for locomotives and tenders is investigating the standardization of pedestal widths for roller bearings on steam, electric and Diesel freight, passenger and switch locomotives and will cooperate with the Car Construction Committee on similar standardization for pedestal widths on tender roller bearings.

Shelling of Trailer Wheel Tires

In February, 1934, the Locomotive Construction Committee appointed a sub-committee to confer with a technical committee of American tire manufacturers, to study failures of driving and trailer wheel tires on locomotives. A questionnaire was prepared, and data collected from Member Roads.

The study on driving wheel tires was completed and so reported in November, 1937, and Member Roads advised to confine the study, commencing June 1, 1937, to the shelling of trailer tires. The data developed that six roads were having most of the trouble, and at a committee meeting March 9, 1938, this study was confined to the Boston & Maine; Chicago & Eastern Illinois; Great Northern; Louisville & Nashville; Norfolk & Western and Southern.

During December, 1938, a committee was appointed, and visited the shops of these six roads to study shelling and shop practices. Suggestions were made by this committee during its visit. The study was continued up to October 1, 1940.

Conclusion

Many of the roads experience no trouble with shelling of non-heat-treated trailer tires, while others have had serious trouble.

This shelling has taken place on particular types of locomo-

Table V—Roller Bearing Applications in the United States and Canada Up to December 1, 1940

	Timken	SKF	ASF	Hyatt	Fafnir	All
Total engine truck bearings applied	2,234	2,278	396	0	0	4,908
Total all driver bearings applied	3,622	518	0	0	0	4,140
Total trailer truck bearings applied	1,258	666	430	0	0	2,354
Total tender truck bearings applied	6,388	4,100	2,340	116	168	13,112
Per cent of total engine truck bearings applied	45.51	46.41	8.08	0	0	.....
Per cent of total driver bearings applied	87.49	12.51	0	0	0	.....
Per cent of total trailer truck bearings applied	53.44	28.29	18.27	0	0	.....
Per cent of total tender bearings applied	48.72	31.27	17.85	0.88	12.81	.....
Per cent bearings reported of total number applied, engine truck	85.58	64.18	50.51	....	....	.....
Per cent bearings reported of total number applied, drivers	90.12	80.31	....	....	....	.....
Per cent bearings reported of total number applied, trailer truck	81.08	70.57	31.16	....	....	.....
Per cent bearings reported of total number applied, tender	96.18	84.39	44.19	100.00	14.28	.....

tives, and in many cases on particular divisions, with locomotives in fast and heavy service.

The record indicates clearly, after approximately four years' study, that the service obtained by the use of heat-treated quenched and tempered) trailer tires has practically overcome the shelling condition, and, in addition, has greatly increased the mileage on tires, as indicated by an average of 22,000 miles per 1/16 in. of wear on heat-treated (quenched and tempered) tires, and an average of 6,800 miles per 1/16 in. of wear on non-heat-treated tires.

This study covered 997 heat treated (quenched and tempered) tires, and 3,972 non-heat-treated tires.

One road made a test of normalized tires, but due to the very poor results obtained, discontinued the purchase.

It is recommended that railroads experiencing trouble due to the shelling of trailer tires use heat-treated (quenched and tempered) tires and follow carefully the Locomotive Tire Manual in the preparation of wheel centers and tires, and the application of tires to the wheel centers.

Locomotive Boiler Construction by Fusion Welding

Since 1935 the Mechanical Division has been following an investigation of the construction of locomotive boilers by the fusion welding process.

At a meeting of the General Committee of the A. A. R. June 25, 1935, action was taken to instruct the Committee on Locomotive Construction to consult with representatives of the locomotive builders and start a preliminary investigation covering the basis of procedure in connection with the subject, and also to include in its study the matter of such tests and research as should be conducted and an estimate of cost.

On October 11, 1935, the committee received a letter from G. S. Edmonds, superintendent motive power, Delaware & Hudson, in which he stated they had for four and one-half years, in collaboration with the American Locomotive Company, been carefully studying and investigating the development of a welded conventional locomotive boiler.

In view of the fact that the D. & H. contemplated building such a boiler, the committee decided to join forces with the locomotive builders and representatives of the welding societies.

A design was developed and presented to J. M. Hall, director Bureau of Locomotive Inspection, Interstate Commerce Commission, with a formal request for permission to proceed with the construction of the boiler. Mr. Hall gave his permission, provided the design of the boiler, specifications and material met the approval of the Committee on Locomotive Construction and also the General Committee. This was all passed upon and approved, and the American Locomotive Company proceeded with construction at its Dunkirk, N. Y., plant, all welding being carefully supervised and X-rayed. Upon completion, it was sent to Chattanooga, Tenn., to be stress relieved, and returned to American Locomotive Company for installation of the firebox and final completion. Hydrostatic and hammer tests were made on March 18, 1937, at the Schenectady, N. Y., plant of the American Locomotive Company. The boiler was then delivered to the Delaware & Hudson and applied to locomotive No. 1219. In order to comply with federal requirements it was used as a stationary boiler for a period of from one month to six weeks for observation and check.

Locomotive No. 1219 was placed in freight service on September 24, 1937, for operation on the Pennsylvania Division of the Delaware & Hudson between Wilkes-Barre and Oneonta, N. Y., a run of 130 mi. The federal requirements stated that in the first year of service the lagging and jacket was to be removed and the joints examined each three months, in the second year each six months, and yearly thereafter for a period of five years. Each time the hydrostatic test was made it was not less than 50 per cent above the working pressure. Following is the report of inspections for the first, second, third and fourth quarters of the first year:

First Quarter: Locomotive No. 1219 was taken out of service at Colonie, N. Y., December 19, 1937, for the first three-months inspection of fusion welded boiler. Jacket and lagging was removed to enable inspection of welded seams. Pressure of 225 lb. was applied and careful inspection made of all welding of shell, wrapper, and firebox sheets of this boiler, and same found in good condition.

Second Quarter: Locomotive No. 1219 was taken out of service at Oneonta, N. Y., March 19, 1938, for the second three-months inspection of fusion welded boiler. Jacket and lagging was removed to enable inspection of welded seams. Pressure of 225 lb. was applied and careful inspection made of all welding of shell, wrapper, and firebox sheets of this boiler, and same found in good condition.

Third Quarter: Locomotive No. 1219 was held at Oneonta, June 18, 1938, for the third three-months inspection of welded seams. Pressure of 225 lb. was applied and careful inspection made of all welding of shell, wrapper, and firebox sheets of this boiler, and same found in good condition.

Fourth Quarter: Locomotive No. 1219 was held at Oneonta, September 17, 1938, for annual test and inspection of fusion welded boiler. Jacket and lagging was removed to enable inspection of welded seams. Hydrostatic test was applied at a pressure of 340 lb. and careful inspection made of all welding of shell, wrapper, and firebox sheets of this boiler, September 20, 1938, and found to be in good condition.

The first semi-annual inspection for the second year of service was made on April 3, 1939, at the Colonie Shops of the Delaware & Hudson, at which time the jacket and lagging was removed to enable inspection of the welded seams in this boiler. A test of 340 lb. pressure was applied and at this inspection it was found that the welding on the shell and wrapper sheets of the boiler and firebox when examined was found to be in good condition. As a matter of fact, since the boiler was first placed in service there have not been any signs of a simmer or leak from any of the welded seams. Up until the time of this inspection the locomotive had approximately 105,000 miles of service.

The second semi-annual inspection in the second year of service was made on November 17, 1939, at Oneonta, N. Y., at which time the jacket and lagging were removed to inspect the welded seams. An hydrostatic test of 350 lb. pressure was applied and careful inspection was made. The welding on shell and wrapper sheets of the boiler and firebox was carefully examined and found to be in good condition. Up to that date there had not been a simmer from any of the welds. The locomotive at that time had 134,000 miles of service.

The first annual inspection of locomotive No. 1219 in its third year of service was made on July 9, 1940, at the Colonie Shops of the Delaware & Hudson in accordance with federal requirements. All conditions of the boiler were found entirely satisfactory.

There will be another inspection for the fourth year of service, probably in July, 1941, and for the fifth year in July, 1942. The committee will continue to follow this matter during the period of inspections required by the I. C. C. Bureau of Locomotive Inspection, and furnish further reports until the conclusion of the test period.

Locomotive Boiler and Firebox Materials and Construction

A questionnaire requesting detailed information on boiler and firebox materials and construction was prepared by the committee and issued to 30 representative railroads and the 3 locomotive builders.

Replies covering 81 classes of locomotives of 15 different types or wheel arrangements have been received and tabulated.

The tabulation shows the latest practice in locomotive boiler construction on the railroads reporting, and the size of the boilers ranges from 73⅝ in. to 103¼ in. inside diameter, first course.

The report contained tabulations of (1) firebox and tube sheet thicknesses; (2) rate of increase in width of water space (a) adjacent to firebox tube sheet, (b) near door sheet; (3) space between crown and roof sheet at back tube sheet and (4) type of threads on fire box end of rigid radial stay bolts, selected to show the trend in design of modern boilers. The figures show a wide variation in practice as to roof and tube sheet thickness and the rate of increase of water space opposite the firebox. The variations appear to be without relation to boiler diameter—used as a basis of comparison.

The information obtained has been tabulated and furnishes a voluminous amount of data on design and construction of modern locomotive boilers, blueprint copies of which can be obtained from the secretary, if desired, at cost of reproduction.

Because of the amount of work and time involved, it has been

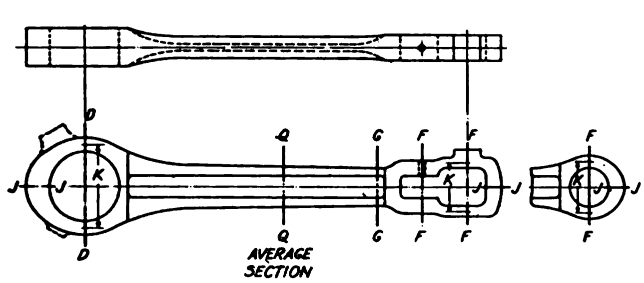
MAIN AND SIDE RODS

S = STRESS IN POUNDS PER SQUARE INCH.
A = NET AREA OF SECTION IN SQUARE INCHES.
P = PISTON THRUST IN POUNDS = AREA OF CYLINDER × BOILER PRESSURE.
B = P ÷ A = LOAD PER SQUARE INCH OF AREA.
L = LENGTH OF ROD BETWEEN PIN CENTERS IN INCHES.
R = RADIUS OF GYRATION OF SECTION IN INCHES.
E = MODULUS OF ELASTICITY OF MATERIAL
h = DEPTH OF SECTION IN INCHES
C = CRANK RADIUS IN FEET
K = SEE SKETCH - INCHES.
Z = SECTION MODULUS OF SECTION

NOTES

1-THE MAXIMUM STRESSES SHOWN ARE FOR CARBON STEEL WITH A TENSILE STRENGTH OF 80,000 LBS. PER SQ. IN., AND A YIELD POINT OF 40,000 LBS. PER SQ. IN. STRESSES MAY BE INCREASED FOR STRONGER STEELS, BUT THE INCREASE SHOULD NOT EXCEED THE PROPORTIONATE INCREASE IN ULTIMATE TENSILE STRENGTH.
2-FORMULA FOR STRESS DUE TO CENTRIFUGAL FORCE IS BASED ON DIAMETER SPEED, EQUIVALENT TO 336 R.P.M. FOR OTHER SPEEDS THE STRESS IS IN PROPORTION TO THE SQUARE OF THE R.P.M., OR THE SQUARE OF THE SPEED IN MILES PER HOUR.
3-LUBRICATION HOLE AND OTHER HOLES SHOULD BE KEPT AT LEAST 30° FROM VERTICAL CENTER LINE.
4-ROD EYES WITH SINGLE BUSHINGS OF THE FLOATING TYPE SHOULD HAVE THE THICKNESS OF METAL INCREASED ⅛ INCH OVER THAT PROVIDED BY FORMULA TO ALLOW FOR WEAR.
5-LIBERAL RADII SHOULD CONNECT ROD BODIES WITH ENDS.

MAIN RODS

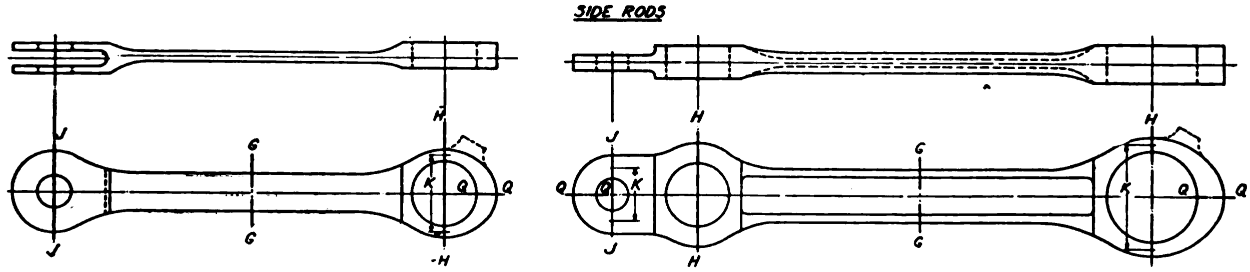


SECTIONS D-D & F-F ARE SECTIONS OF LEAST AREA

SECTION	STRESSES	FORMULAE	MAXIMUM
G-G	① DIRECT STRESS	$S = P \div A$	10,000
Q-Q	② TRANSVERSE BENDING	$S = \dfrac{B}{1-\left(\dfrac{B}{40E} \times \dfrac{L^2}{R^2}\right)}$	11,000
Q-Q	③ BENDING (COLUMN VERTICAL)	$S = \dfrac{B+2}{1-\left(\dfrac{B}{20E} \times \dfrac{L^2}{R^2}\right)}$	5,500
Q-Q	④ BENDING (CENTRIFUGAL FORCE) NOTE-2	$S = .68\left(\dfrac{L}{R}\right)^2 \times \dfrac{h}{Z} \times C$	10,000*
Q-Q	⑤ COMBINED VERTICAL BENDING	S = ③ + ④	15,000*
F-F	⑥ DIRECT STRESS	$S = P \div A$	7,000
F-F	⑦ BENDING	$S = \dfrac{P \times K}{20Z}$	20,000
D-D	⑧ DIRECT STRESS	$S = P \div A$	6,000
D-D	⑨ BENDING	$S = \dfrac{P \times K}{20Z}$	20,000
J-J	⑩ BENDING	$S = \dfrac{P \times K}{12Z}$	20,000

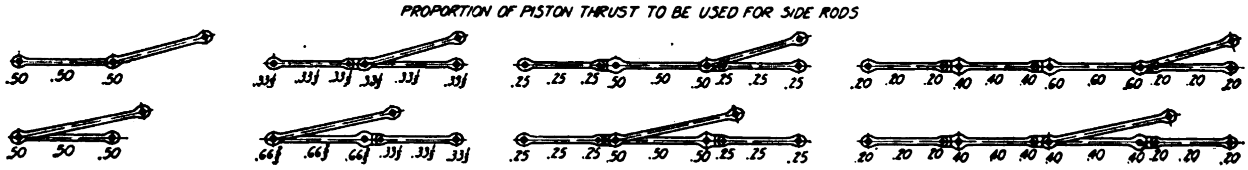
*AT MAXIMUM SPEED

SIDE RODS



SECTION H-H IS SECTION OF LEAST AREA

PROPORTION OF PISTON THRUST TO BE USED FOR SIDE RODS



FOR I SECTION AND RECTANGULAR RODS

SECTION	STRESSES	FORMULAE	MAXIMUM
G-G	① DIRECT STRESS	$S = P \div A$	6,000
G-G	② TRANSVERSE BENDING	$S = \dfrac{B}{1-\left(\dfrac{B}{40E} \times \dfrac{L^2}{R^2}\right)}$	7,000
G-G	③ BENDING (CENTRIFUGAL FORCE)	$S = .68\left(\dfrac{L}{R}\right)^2 \times h \times C$	10,000*
G-G	④ COMBINED DIRECT STRESS AND BENDING	S = ① + ③	14,000*
H-H	⑤ DIRECT STRESS	$S = P \div A$	4,000
H-H	⑥ BENDING	$S = \dfrac{P \times K}{20Z}$	16,000
Q-Q	⑦ BENDING	$S = \dfrac{P \times K}{12Z}$	16,000
J-J	⑧ DIRECT STRESS	$S = P \div A$	4,000
	⑨ KNUCKLE PIN BEARING PRESSURE	$B = P \div A$	4,000

* AT MAXIMUM SPEED

Proposed formulas for stresses on main and side rods

impossible to formulate recommendations in the report this year. The subject will receive further consideration during the coming year.

Research on Axles, Crank Pins and Bearings

An outline of test covering three different methods of making the crank pin fit in the wheel center and methods of converting the axle testing machines at the plant of the Timken Roller Bearing Co. in order to make the crank pin tests have been worked up. Appropriation for making the test has been granted by the Association, and tests will be started as soon as possible after the work of testing car axles is concluded. This will be approximately August, 1941. It is anticipated that a full report on the results of these tests will be ready for the annual meeting in 1942.

Stresses in Locomotive Rods and Motion Work

The committee was assigned the task of revising the Standard Checking Formulas for Main and Side Rods which were adopted in 1914 and are shown on Pages F-9 to 13, inclusive, of the Manual, with the particular purpose of providing designs which will have the required strength without excess weight.

During the progress of the study, many existing designs of main and side rods on various types of locomotives were investigated and analyzed, and the formulas now proposed, with the stress limitations shown, represent the conclusions reached to attain the desired objectives.

An effort has been made to simplify the processes of calculation and the two pages were submitted for inclusion in the Manual as recommended practice to cover all the necessary formulas for main and side rods.

Standardization of Wrought Steel Wheels for Diesel Locomotives

The sub-committee submitted a questionnaire to railroads and manufacturers asking for information in connection with the present design of wrought steel wheels used on Diesel locomotives.

From the data collected, a table of proposed standards was prepared and included in the report of Committee on Wheels, dated May 27, 1940.

This table has been revised to include wheels of 33 in. diameter and appears, in revised form, in Fig. 4.

The committee feels that the standardization of wrought steel wheels for Diesel locomotives is absolutely necessary at this time; further, that there would be no conflict with wheel and axle tests now being conducted by the A. A. R., and it is felt that these proposed standards can be adopted.

It was recommended that they be submitted to letter ballot.

Standardization of Wrought Steel Wheels for Locomotive Trailer Trucks

The sub-committee appointed to investigate and make recommendations on the standardization of the design of wrought steel wheels for locomotive trailer trucks prepared a questionnaire and solicited information from 142 railroads; replies were received from 117 roads.

The tabulation of this data shows 90 different designs of trailer wheels in use with wide variations. A further study of this data is now being made.

Progress is being made on the preparation of a table to show the proposed Standard of Wrought Steel Wheels for Locomotive Trailer Trucks.

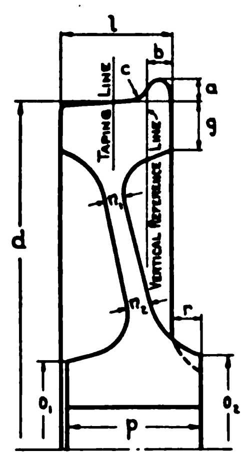
Standardization of Wrought Steel Wheels for Locomotive Tenders

Data was collected by the sub-committee, and a table of proposed standards was prepared. Tentatively, this table was included in Report of Committee on Wheels, dated May 27, 1940.

At meeting of the sub-committee held in New York on January 16, 1941, it was decided to continue the above subject, awaiting the completion of tests of axles and wheels now being conducted on the A. A. R. test machine at the Timken Roller Bearing Company's Plant at Canton, Ohio.

The report was signed by H. H. Lanning (chairman), mechanical engineer, A. T. & S. F.; H. P. Allstrand (vice-chairman), assistant to chief executive officer, C. & N. W.; E. L. Bachman, general superintendent motive power, Pennsylvania; F. E. Russell, mechanical engineer, Sou. Pac.; W. F. Connal, chief mechanical engineer, Can. Nat'l; J. E. Ennis, Engineering assistant, N. Y. C.; J. B. Blackburn, mechanical engineer, C. & O.; L. H. Kueck, chief mechanical engineer, Mo. Pac.; W. H. Sagstetter, chief mechanical officer, D. & R. G. W.; and K. Cartwright, mechanical engineer, N. Y., N. H. & H.

MULTIPLE WEAR WROUGHT STEEL DIESEL LOCOMOTIVE WHEELS



* Min. Hub Wall 1 1/2".

** Standard Wheels Have Diameters As Shown In The Table With Rims 2 1/2" Thick.

If Rim 3" Thick Is Used The Metal Is Added On The Outside Making The Actual Minimum Diameters 34, 37, 39, 41, 43".

*** Wheels Used In Switching Service May Be Specified 1/8" Greater.

Dimensions With Tolerances.

Axle Class	5 1/2" × 10"	6 1/2" × 12", 7" × 13", 7 1/2" × 14"	6 1/2" × 12", 7" × 13", 7 1/2" × 14"	6 1/2" × 12", 7" × 13", 7 1/2" × 14"	6 1/2" × 12", 7" × 13", 7 1/2" × 14"
Wheel Class	33 I	36 F	38 C	40 C	42 C
a	1" +1/16" −0	Same	Same	Same	Same
b	1 5/32" +1/16" −0	Same	Same	Same	Same
c	11/16" +1/16" −1/16"	Same	Same	Same	Same
** d	33" +14 Tapes −0	36" +14 Tapes −0	38" +14 Tapes −0	40" +14 Tapes −0	42" +14 Tapes −0
** g	2 1/2" Min. 3" Min.	Same	Same	Same	Same
l	5 1/2" +1/8" −1/8"	Same	Same	Same	Same
*** n_1	3/4" Min.	3/4" Min.	7/8" Min.	7/8" Min.	1" Min.
*** n_2	1" Min.	1" Min.	1 1/8" Min.	1 1/8" Min.	1 1/4" Min.
* o_1	11"	13 1/2"	Same	Same	Same
* o_2	11"	13 1/2"	Same	Same	Same
p	6 1/2 or 7" +1/8" −1/8"	Same	Same	Same	Same
r	If Rough Machined 1 11/16" +1/16" Min. +3/16" Max.	Same	Same	Same	Same

Multi-wear wrought-steel wheels for Diesel locomotives

Discussion

In discussing this report, the privilege of the floor was extended to manufacturers of both steam and Diesel locomotives.

R. T. Sawyer, sales engineer, American Locomotive Company, said that the report contains the most comprehensive figures on Diesel locomotive maintenance costs which he has seen up to the present time. He stated that a careful analysis of Alco Diesel locomotive maintenance costs shows that 900- and 1,000-hp. switchers average 29 cents an hour, these locomotives being about two years old. Alco 600-hp. Diesel switchers, which have been in service upwards of four years, are costing 28 cents an hour for maintenance.

L. Richardson, mechanical assistant to vice president and general manager, Boston and Maine, asked the committee what other changes in globe and angle valves for 300 lb. are referred to in the report. Chairman Lanning replied that nothing of great importance was being studied, but the committee were considering a provision for a bonnet bushing and also a valve design for higher temperature and pressure.

J. M. Hall, director, Bureau of Locomotive Inspection, I. C. C., stressed the importance of having good threads on valves, which did not mean valves with threads that only tightened on the last half turn. He spoke of 300-lb. valves of a special material being produced by some manufacturers that will not deteriorate which are well worth the consideration of the Mechanical Division.

E. B. Hall, chief mechanical officer, C. & N. W., asked if the committee took account of the range in carbon content necessary to avoid the shelling of trailer wheels, and said that experience

on the C. & N. W., indicates the probability of trouble with a carbon content above 0.72 per cent.

H. W. Coddington, chief chemical and test engineer, N. & W., said that trouble with trailer tire shelling on the N. & W. did not seem to follow any direct reason, but it was cured by proper heat treatment, the hardness being kept within a range of Brinell 321 to 363. He stated that experience with heat-treated tires on the N. & W. is highly gratifying.

C. B. Bryant, engineer of tests, Southern, said that shelling of trailer tires on this road has been confined to a small group in one territory and that the solution of the problem did not require going to heat-treated tires.

In discussing that part of the report devoted to a fusion-welded boiler, A. G. Hoppe, assistant mechanical engineer, C. M. St. P. & P., called attention to the record of the D. & H. boiler in having stood several weeks of stationary test service, three years of road service and now almost 12 additional months of road service without any indication of distress, or even minor leakage. He suggested that this type of construction may help solve the problem of securing adequate capacity in modern high-pressure steam locomotive boilers and still keep within space and weight limitations without going to the use of high-tensile alloy steels.

Mr. Hoppe mentioned difficulties in designing boiler-shell portions for 285 to 300 lb. pressure and said that in addition to increasing the weight unnecessarily, single- and double-lap riveted seams introduce abrupt changes in boiler section with attendant unsymmetrical design, stress concentrations and the possibility of cracks developing. This is due to mechanical working and also to caustic embrittlement which implies a combination of high stress in conjunction with small leaks of concentrated boiler water having certain chemical characteristics. Repairs to this type of construction not only keeps the locomotive out of service, but reproduces the construction in kind and does not get away from the difficulties.

Mr. Hoppe said that designs have apparently reached the limit of construction with conventional riveted boilers in which severe forming stresses, in conjunction with cold working and heavy calking, intensify stress concentration and are a potential source of difficulty. He urged the immediate need of utilizing welded boiler construction and said that if this cannot be permitted until some later date, the intermediate time should be utilized in preparing rules and regulations to govern the safe construction of fusion-welded boilers.

He also suggested that rules for the proper construction of welded boilers should include the use of modern X-ray testing equipment, stress-relieving furnaces, etc., which will permit going back to low-carbon steel. He said he is not suggesting that fusion-welded boilers be constructed in railroad shops, but that they be purchased from reliable locomotive and boiler manufacturers having necessary modern welding technique and equipment.

John M. Hall, director, Bureau of Locomotive Inspection, I. C. C., said that welding methods, equipment and materials, including the covered electrode, have been vastly improved during the past decade, making possible the D. & H. fusion-welded boiler which was constructed of selected materials, with down-hand welding, most carefully supervised and that the boiler was subsequently stress relieved. He said that this boiler has given excellent service to date but this limited experience is not enough to justify letting individual railroads go ahead at will and use boilers constructed by the fusion-welding process. Even on the D. & H. boiler, Mr. Hall said that if a crack develops it will have to be repaired by conventional methods rather than welding, which is a manufacturer's job.

James Partington, manager, engineering department, American Locomotive Company, said that the welded boiler in industry is an established fact and he hoped that all present would live to see welded boilers widely used in railway service. He said that the boiler difficulties mentioned by Mr. Hoppe can be duplicated on other roads. To permit stress relieving any welded boilers it may build, the American Locomotive Company has available a large annealing furnace at Dunkirk, N. Y. Mr. Partington stated that adequate welding rules are now in existence and, in fact, many welded locomotive-type boilers embodying welded construction and utilizing pressures up to 350 lb. are now in use largely in the oil industry. He paid tribute to the ability of railroads to do a greatly improved welding job, as compared with a few years ago, many roads now following the American Welding Society rules for qualifying welders, using covered electrodes, and doing good welding jobs. Mr. Partington said that the riveted boiler has come to a place where it must be improved and the construction of welded stationary boilers carrying up to 2,200 lb. pressure in drums and superheaters shows what can be done. Mr. Partington paid tribute to the American Welding Society and the Boiler Code Committee of the American Society of Mechanical Engineers, which have made a real contribution to the improvement of welding standards and performance.

Chairman Lanning referred to the important but limited amount of information regarding rod stresses, included in the committee report, and said that the formulae presented by Mr. Ennis represents almost two years' work on the part of both railroads and the builders; and these rod designs have been tested and represent the lightest safe weights usable in high-speed service.

C. T. Ripley, chief engineer, Technical Board, Wrought Steel Wheel Industry, expressed appreciation for the opportunity of working with the committee and made a strong plea for greater standardization of steel wheels used in all classes of service. He said that standardization produces a number of definite benefits, such as reduction in unit cost, fewer wheels carried in stock, more prompt delivery and that these advantages are especially important today. Mr. Ripley suggested that, as a preliminary to reducing the great number of steel wheel sizes and types now in use, it would be well worth while for each road to appoint a single competent man to canvass the steel wheel situation on that road, determine how many non-standard wheels are being used and see what can be done to reduce the number. He said, for instance, that in his opinion the 20 standard Diesel locomotive wheel sizes could be readily reduced to five. He suggested that the Locomotive Construction Committee study the subject of trailer hub wheels faces of which there are a great variety of sizes far more numerous than necessary to meet varying strength requirements. Mr. Ripley said there should be a possibility of reducing about 90 of these sizes to 6. He urged that more railroads follow the recommendations of the highly competent Wheel Committee, and any roads which feel it necessary to depart from the standards in particular instances to submit proposed variation to the committee before burdening the railroads and the wheel industry with additional non-standard steel wheels.

Chairman Lanning said that in view of the urgency of the trailer wheel problem, improvements in wheel construction and design will be made available to the Mechanical Division membership by the committee without waiting for the annual meeting. The committee has under consideration the subject of standardizing trailer hub wheel faces, as suggested by Mr. Ripley.

The report was accepted and referred to letter ballot.

Report of Arbitration Committee

During the year Cases 1779 to 1785, inclusive, have been decided and copies forwarded to the members.

Upon recommendation by the Committee on Brakes and Brake Equipment, a new requirement under Rule 3 is recommended for submission to letter ballot, to make mandatory the use of Standard extra heavy air-brake pipe on all cars built new or rebuilt on or after January 1, 1942, account difficulties being experienced due to failure and leakage of light-weight pipe.

With the concurrence of the Committee on Car Construction and Committee on Couplers and Draft Gears, it is recommended that the effective date of Rule 3 requirement prohibiting acceptance from owners of cars equipped with 5-in. by 5-in. couplers, be extended to January 1, 1943, with proviso it is contemplated no further extension beyond this date will be granted.

The modification of Rule 12 is recommended, to provide that joint evidence to be valid must be obtained within two years after date of repairs. It is felt that if original repairs have given satisfactory service for a two-year period, there is no justifiable reason for making correction at expense of initial repairing line.

Upon recommendation by the Committee on Couplers and Draft Gears, a new requirement is added to Rule 18 prohibiting the burning out of key slots in couplers and requiring removal of such couplers when found in service at expense of car owner. The item has also been added to Rule 19 as prohibited repairs to foreign cars. It is felt that such couplers constitute a hazard in service.

New requirements are added to Rule 60, upon recommendation by the Committee on Brakes and Brake Equipment, making mandatory the substitution of improved parts and elimination of certain details of the AB brake equipment when brakes receive periodic attention.

Recommendations are offered for modification of Rules 112 and 120 to permit car owners to request the return of serviceable AB brake equipment from his cars when dismantled on foreign lines. Rule 120 is also modified to harmonize with Rule 112 with respect to returnable items.

Revision of Rule 113 is recommended to provide that the car owner will be responsible for damage or destruction of a private car by fire, explosion or other condition beyond control of delivering line, while located on private tracks belonging to or leased to lessee of car, it being considered inequitable to place responsibility upon delivering line in such cases. A second modification is proposed, to protect the car owner in cases where privately owned cars are damaged or destroyed on the tracks of a non-subscriber road to which the car has been delivered without authority of owner or lessee.

A new requirement is added to Passenger Rule 7 to provide that the failure of roller bearing units, or combination roller bearing and friction bearing units, due to defects or overheating, will be a car owner's responsibility. The maintenance of roller bearings is generally performed by car owner and foreign lines have practically no opportunity to protect themselves against such failures. This recommendation is concurred in by the Committee on Lubrication of Cars and Locomotives.

Studies of the overhead allowance now used in formulating the A. A. R. labor rate are being made and, if it develops that modification is necessary as result of these studies, with the approval of the General Committee the revision will be incorporated in the 1942 Code.

With the exception of the Rule 3 requirement above mentioned, the committee does not feel that any of the modifications included in its report necessitate submission to letter ballot.

All recommendations for changes in the Rules of Interchange submitted by members, railroad clubs, private car owners, etc., have been carefully considered by the committee and, where approved, changes have been recommended.

Attention is again directed to the fact that the Arbitratior Committee will not consider questions under the Rules of Inter change unless submitted in the form of Arbitration Cases as pei Rule 123.

Freight-Car Rules

Rule 2

The committee recommends that Paragraph (1) of Section (g) of this rule be modified as follows:

Proposed Form: (g) (1) A. A. R. Car Service Rule 14 will apply when transfer or rearrangement of lading is necessary, including application of proper door protection *when car shows evidence from exterior inspection that load has shifted.*

Reason: To clarify the intent.

Rule 3

The committee recommends that effective dates for various requirements in the present rule, as listed below, now set at January 1, 1942, be extended to January 1, 1943:

Section (b), Paragraph (7)—Brake levers: Metal badge plates.

Section (b), Paragraph (8)—Bottom rod and brake beam safety supports.

Section (b), Paragraph (9)—Braking power.

Section (c), Paragraph (11)—Couplers having 5 by 5-in. shanks.

Note.—The committee does not contemplate granting a further extension in effective date of the requirement prohibiting acceptance from owners of cars equipped with 5 by 5-in. couplers, beyond January 1, 1943. This proviso has the concurrence of the Committee on Car Construction and Committee on Couplers and Draft Gears.

Section (c), Paragraph (12)—Couplers, former standard (except type D) or temporary standard having 5 by 7-in. shanks.

Section (j), Paragraph (2)—Journal boxes, repacking of.

Section (t), Paragraph (3)—Application of welded side frames having T- or L-section compression or tension members.

Section (u), Paragraph (4)—Class E-3 cars not to be accepted from owner.

The committee recommends that a new paragraph and note be added to Section (a) of this rule effective January 1, 1942, subject to approval by letter ballot, to read as follows:

Air brake pipe: Extra heavy pipe (except nipples at angle cocks, which should be of standard weight) required on all cars built new or rebuilt on or after January 1, 1942. From owners.

Note.—It is recommended that when brake pipe is renewed on cars built prior to January 1, 1942, extra heavy pipe as above be used.

Reason: To make mandatory the use of standard extra heavy pipe, account difficulties experienced due to failure and leakage of light-weight pipe, as recommended by the Committee on Brakes and Brake Equipment.

The committee recommends that fourth paragraph of Section (c) and Interpretation No. 1 of this rule be eliminated.

Reason: No longer necessary on account of obsolete construction.

The committee recommends that third paragraph of Section (d) of this rule be modified and Interpretation No. 5 eliminated, as follows:

Proposed Form: (d-3) Draft key retainer, A. A. R. Standard, or approved equivalent, or A. A. R. Alternate Standard one-inch diameter hair pin type, required *in all horizontal draft keys (one, two or three key attachment), on all cars. However,* draft-key retainer with *not less than ⅝-in. thickness of head will be accepted on* cars built prior to March 1, 1929, where the underframe construction will not accommodate the *A. A. R. Standard* one-inch thickness of head. From owners.

Reason: To eliminate Interpretation No. 5.

The committee recommends that note following fourth paragraph of Section (t) of this rule, be modified, effective August 1, 1941, as follows:

Proposed Form: (t-4) No change.

Note.—The movement of cars equipped with arch bar trucks must be confined to owner's rails, except that they are acceptable in interchange from owner for loading or for unloading within the same terminal switching district in which the interchange occurs, and providing that cars so interchanged will be immediately returned to owner's rails when loading or unloading is accomplished.

Cars, *locomotive cranes, tenders and derricks,* equipped with arch bar trucks, are acceptable for movement between plants located in the same switching district.

Reason: To clarify the intent.

Rule 4

The committee recommends that Paragraph (1) of Section (h) of this rule be modified, effective August 1, 1941, as follows:

Proposed Form: (h) (1) Tank cars.—Sheets, heads or domes of non-insulated cars, when bent inwardly in excess of 8-in. by 8-in., or equivalent area, or when bent inwardly in excess of ¼-in. in depth regardless of area; however, dents *or cracks* in heads due to former head-block anchorage, *or in sheets due to contact with cradle or saddle blocks,* will be owner's responsibility.

Reason: Damage due to such causes should be the responsibility of car owner.

Rule 9

The committee recommends that first requirement opposite "Wheels and axles, R. and R." in this rule, covering information to appear on repair cards, be modified, effective August 1, 1941, as follows:

Proposed Form: Cast-steel; wrought-steel; 1-W wrought-steel; steel-tired; or cast-iron wheels (whether single-plate *bracketed, single-plate not bracketed,* or double-plate, which must be indicated by letters *"S. P. B.," "S. P. N. B.,"* or "D. P.," *respectively,* in service metal column).

Reason: As recommended by the Committee on Wheels, such information being necessary in connection with studies of cast-iron wheel failures.

The committee recommends that requirement for classification number opposite item of "Brake shoes, applied," be eliminated.

Reason: It is felt this information is no longer necessary on billing repair cards, as the former standard shoe has not been manufactured for several years and is no longer in service. Furthermore, Rule 19 prohibits the application of other than the standard or alternate standard shoes in repairs to foreign cars and Rule 3 prohibits acceptance of cars from owners unless equipped with the A. A. R. Specification shoe.

Rule 12

The committee recommends that second paragraph of this rule be modified and Interpretation No. 1 eliminated, as follows:

Proposed Form: At points where it is impracticable for a railroad company to obtain joint evidence, the evidence of car owner shall *suffice* provided it is *signed only* after *an* actual inspection by *any railroad* representative *designated by the car owner as competent to make such inspection.*

(Vacant.)

Reason: To eliminate the interpretation.

The committee recommends that fifth paragraph of this rule be modified as follows:

Proposed Form: Joint evidence must be obtained within 90 days after first receipt of car home, *but in no case exceeding two years after date of repairs,* and said joint evidence shall not be valid unless used within 16 months from date of issue.

Reason: It is felt that if original repairs have given satisfactory service for a period of two years, there is no justifiable reason for making correction at expense of initial repairing line.

Rule 14

The committee recommends that second paragraph of this rule be modified as follows:

Proposed Form: Facing the B end of car, in their order on the right side of car, wheels, journal boxes and contained parts (*including box lids*), shall be known as R1, R2, R3 and R4, and (etc.—no other change).

Reason: To clarify the intent.

Rule 17

The committee recommends that new last sentence be added to Paragraph (4), Section (c) of this rule, to read as follows:

(c-4) Equipment markings (for couplers, draft gears, etc.) are not required; however, the rules do not prohibit application of such markings by car owner. If car bears previous markings for couplers, in the event of first application of D or E type coupler; or if A. A. R. approved draft gear is applied in place of non-approved or obsolete type of draft gear, and car bears previous markings for latter gears; such markings must be changed to correspond with coupler or draft gear applied (for the particular end, A or B, or both ends, as the case may be) for which a charge of ½-hr. may be made. In event of failure of repairing line to correct markings under such circumstances, defect card shall be issued for ½-hr. labor to cover. *In such cases the words "A. A. R. APPVD. DRAFT GEAR" may be used in lieu of specifying the particular name and type of approved draft gear applied.*

Reason: To eliminate necessity of preparing stencils for the many types of draft gears.

The committee recommends that a new Paragraph (6) be added to Section (c) of this rule (present Paragraph 6 to be relocated as new Paragraph 7), effective August 1, 1941, to read as follows:

(6) When old style bottom rotary lock lift lever or toggle is found defective on an A. A. R. Standard Type E coupler, repairing line has the option of renewing old style parts in kind or may substitute as correct repair complete new type assembly having the two parts riveted together. In the latter case, full charge may be made and scrap credit allowed for the old style parts removed (see Rule 101 for charges and credits).

Reason: As recommended by the Committee on Couplers and Draft Gears.

The committee recommends that Paragraph (d) of this rule be modified as follows:

Proposed Form: (d) Bolts substituted for rivets, where rivets are the standard of the car, are considered as improper repairs, except where used in securing ladders, ladder treads, handholds, sill steps and uncoupling lever brackets, *on all cars of all types;* also *proper to use bolts* for securing coupler and draft gear supports on tank cars; *except, that in no case shall bolts be substituted for rivets which pass through the shell* or metal jacket of tank *of tank cars.* The substitution of bolts for rivets, or (etc.—no other change).

Reason: To clarify the intent.

The committee recommends that three new sentences be added to Note 2 following Section (e) of this rule, effective August 1, 1941, to read as follows:

Note 2.—The A. A. R. brake beam with strut designed for third point suspension is an optional A. A. R. Standard and must be maintained in repairs where standard to car. Therefore, substitution of beam without provision for third point suspension constitutes wrong repairs subject to defect card for labor and material. *Sliding chair castings must be transferred from beam removed to beam applied. A brake beam with No. 1656 sliding chair may be applied as correct repairs in replacement of beam having optional design of strut and former type No. 1293-B sliding chair. Material charge is permissible only when sliding chair on beam removed is missing or defective, and where beam with chair casting is standard to car.*

Reason: The former type sliding chair is obsolete and has not been manufactured since 1934.

The committee recommends that new explanatory note be added to Section (i) of this rule, effective August 1, 1941, to read as follows:

Note.—The term "interchangeable as to sill spacing and coupler pocket limits" means that gear applied should preferably be of the same height, width and length as the gear removed. In the substitution of gears the length (including the number of followers required for the type of gear applied) must be such as to properly fit the coupler yoke. Gears applied must conform with draft-sill construction of car and, if practicable, with existing draft-gear supports and guides. Any modification of the sill construction such as cutting or burning of slots for accommodation of transverse spring rods or of holes for accommodation of different design of guides or supports is not permissible.

Reason: To clarify the intent with respect to draft-gear substitution. This recommendation has the concurrence of the Committee on Car Construction and Committee on Couplers and Draft Gears.

Rule 18

The committee recommends that Paragraph (1) of Section (a) of this rule be modified as follows:

Proposed Form: (a-1) Couplers, types D and E, with distance between point of knuckle and guard arm exceeding 5$^{5}/_{16}$ in. as measured by gage (Fig. A, page 56), must have the defective part or parts renewed to bring coupler within required gage of 5⅛ in. as measured by gage (Fig. C, page 57). If coupler is out of gage, the body must not be renewed unless the application of secondhand, reconditioned or new *lock, or knuckle, or both,* will not bring it within the required gage of 5⅛ in. *Likewise, knuckle must not be renewed unless the application of secondhand, reconditioned or new lock will not bring coupler within the required gage of 5⅛ in.*

Reason: To clarify the intent that, where renewal of parts will correct defective condition, renewal of complete coupler is not justified. This recommendation has the concurrence of the Committee on Couplers and Draft Gears.

The committee recommends that a new Paragraph (2) be added to Section (c) of this rule [present Paragraphs (1) and (2) to be relocated as Paragraphs (1-a) and (1-b)] effective August 1, 1941, to read as follows:

(2) Burning out of key slots in any type of coupler body is prohibited. When couplers with burned-out key slots are removed for any reason or, if such couplers are found in service, they must be removed at the expense of car owner.

Reason: Coupler with burned-out key slots constitutes a hazard in service. As recommended by the Committee on Couplers and Draft Gears.

The committee recommends that the caption appearing in Fig. D, Rule 18 reading "Condemning limit for cracks *horizontally inclined,*" be modified to read "Condemning limit for cracks *extending in any direction.*"

Reason: To clarify the intent.

The committee recommends the addition of a new section (d) to this rule, effective August 1, 1941, to read as follows:

(d) Top Lock Lifters—Type D Couplers. Lock Lifters, No. 1

or No. 2 which have not been converted to No. 3, may be replaced with lock lifter No. 3 at car owner's expense, whether or not the No. 1 or No. 2 is defective.

Reason: As recommended by the Committee on Couplers and Draft Gears, to prevent couplers from opening in service.

Rule 19

The committee recommends that a new item be added to this rule (which specifies materials that must not be used in making repairs to foreign cars), effective August 1, 1941, to read as follows:

Coupler body having burned-out key slots.

Reason: **Coupler with burned-out key slot constitutes a hazard in service. As recommended by the Committee on Couplers and Draft Gears.**

The committee recommends the effective date for eleventh item under this rule, now set at January 1, 1942, be extended for one year, to read as follows:

Welded cast-steel truck side frames having T- or L-section compression or tension members, on and after January 1, *1943.*

Reason: To harmonize with extension recommended under Rule 3.

The committee recommends the addition of a new item to this rule, effective August 1, 1941, to read as follows:

Lock lifters, top, Type D, No. 1 or No. 2 (which have not been converted to No. 3.)

Reason: As recommended by the Committee on Couplers and Draft Gears.

Rule 23

The committee recommends that effective date of requirement prohibiting the welding of cast-steel truck side frames having T- or L-section compression or tension members, now set at January 1, 1942, be extended to January 1, 1943.

Reason: To harmonize with extension recommended under Rule 3.

The committee recommends that eighth paragraph of Section IV of this rule be modified as follows:

Proposed Form: Couplers: Welding cracks in guard arm and back wall of coupler head in accordance with practice described on pages 479-506 of the 1932 Mechanical Division Proceedings, and including couplers with *cracks extending in any direction but not* beyond the welding limits indicated in Paragraph (c) of Rule 18.

Reason: To harmonize with change in Fig. D of Rule 18.

Rule 32

The committee recommends that Section (2) of this rule be modified as follows:

Proposed Form: (2) *Stop* cock, or valve *for similar purpose,* attached to bottom *cap of bottom* outlet valve *nozzle,* if missing, providing car is stenciled "Valve attached to outlet *cap.*"

Reason: to clarify the intent.

The committee recommends that a new last sentence be added to Paragraph (c) of Section (10) of this rule, effective August 1, 1941, to read as follows:

(c) Train collision, Section (d) shall apply in cases of damage due to locomotive, or locomotive with draft of cars, coupling to train or to draft of cars.

Reason: To clarify the intent.

Rule 44

The committee recommends the addition of new Notes D and E following Paragraph (4-c) of this rule and modification of Interpretation No. 1 thereto, effective August 1, 1941, to read as follows:

Note D—When failure of underframe as described in Paragraph (2), (3), or (4) on cars other than tank cars occurs through old or progressive fracture, or due to failure of cast-steel draft extension on car having two center sills; a joint inspection certificate so indicating, signed by a joint inspector or by two inspectors, one of whom must represent a disinterested railroad, shall constitute sufficient evidence that damage occurred in ordinary handling provided, after investigation, it is found that car was not subjected to unfair handling as provided by Paragraph (a), (b), (c), (e), (f), (h), (i), (j), (m), (n), (O-1) and (q) of Section (10) of Rule 32. Whether or not the labor cost of repairs in such cases exceeds the limits of Rule 120, the car shall be reported to car owner and handled under the provisions of that rule.

Note E—When failure of underframe as described in Paragraph (2), (3), or (4) on cars other than tank cars is discovered when car is in train road haul or upon arrival at terminal and prior to switching, the damage will be considered as having occurred in fair usage and, therefore, car owner's responsibility; provided, however, after investigation it is found car was not subjected to unfair handling as described in Paragraphs (a), (b), (c), (d), (e), (f), (h), (i), (j), (m), (n), (o-1), and (q) of Section (10) of Rule 32, that there is no knowledge or record of the defective condition existing prior to car being placed in such train and that there was no switching of one or more cars in train enroute. Whether or not the labor cost of repairs in such cases exceeds the limits of Rule 120, the car shall be reported to car owner and handled under the provisions of that rule.

Interpretation. (1) Q—Is a brief statement that car was not damaged under any condition prescribed in Rule 32 sufficient to establish the responsibility of car owner?

A.—No. Except as provided in last sentence of Note C, and Notes D and E. Statement must show details of the circumstances under which the damage occurred, so that owner may know how responsibility was determined.

Reason: To more equitably allocate responsibility for failure of center sills.

Rule 59

The committee recommends that a new last sentence be added to first paragraph of this rule, to read as follows:

Proposed Form: Rule 59. Missing centrifugal dirt collectors from cars built or rebuilt prior to August 1, 1929, where such cars are stenciled that they are so equipped. ***However, such stenciling is not required on any car equipped with AB brakes, regardless of date built.***

Reason: Centrifugal dirt collectors are a standard part of the AB brake installation.

Rule 60

The committee recommends that Paragraph (f) of this rule be modified as follows:

Proposed Form: (f) All old cleaning marks must be scraped off and painted over with quick-drying paint, preferably black. The place, month, day and year of cleaning and the ***railroad or private line reporting marks,*** must be stenciled with white paint on the auxiliary reservoir, (etc.—no other change).

Reason: To harmonize with changes made in cuts on pages 124 and 125.

The committee recommends that last sentence in Paragraph (g) of this rule, reading as follows, be eliminated:

Effective January 1, 1935, triple valves applied in repairs to all cars must be equipped with the heavier type graduating springs (piece Nos. 18286 or QT 369), regardless of type in valve removed; for which no additional charge is permissible.

Reason: No longer necessary account covered in the A. A. R. Standard Code of Tests.

The committee recommends that new third and fourth notes be added to Section (1) of this rule, and present first and second notes reversed for easier reference, effective August 1, 1941; the new notes to read as follows:

Note 3.—AB brakes receiving periodic attention on and after August 1, 1941, must have improved parts substituted for those of previous designs and piece numbers. Extra charge will be allowed for the improved type strainer, the COT&S allowance being modified to include value of the other items. The improved type parts referred to are as follows:

Quick-action chamber charging choke Pc. No. 506277 or CV-265.
Brake pipe strainer .... Pc. No. 502904 or CV-232.
Emergency piston spring .... Pc. No. 501006 or CV-227.
Reservoir release valve end plate .... Pc. No. 94963 or CV-173.
Wasp excluder barrier in the quick-service vent passage .... Pc. No. 515820 or CV-276.

Note 4.—When AB brakes are given periodic attention, the service portion applied must have had two by-pass check valves (Pc. No. 502140 or CV-250), two springs (Pc. No. 93926 or CV-140), one check valve seat (Pc. No. 502902 or CV-255), and one check valve seat gasket (Pc. No. 93928 or CV-134), removed

and the port drilled to 39/64 in. diameter and suitably plugged, for which no extra charge is permissible.

Reason: As recommended by the Committee on Brakes and Brake Equipment.

Rule 66

The committee recommends that a new last sentence be added to Section (b) of this rule, to read as follows:

(b) All journal boxes shall be jacked; all journal wedges and bearings removed for examination, and renewed where necessary; all boxes cleaned and repacked with properly prepared packing (new or renovated) in accordance with A. A. R. Standard Practice (except the use of the back roll which is optional with repairing company), and car stenciled. Dust guards shall be renewed, when necessary, only where wheels, journal boxes or unit side frames are removed. *Missing or defective dust guard plugs shall be renewed.*

Reason: In all cases where boxes are repacked, these plugs should be used to exclude dirt and cinders from the journal box.

Rule 74

The committee recommends that a new note be added to this rule, to read as follows:

Note.—Wheels condemned under this rule should be shown on repair records as "Vertical Flange" or "Thin Flange," as the case may be, rather than "Worn Flange."

Reason: It is felt this detail information should be available to the car owner.

Rule 94

The committee recommends that third paragraph of this rule be modified, effective August 1, 1941, as follows:

Proposed Form: If the owner elects to dismantle the body or trucks, or both, charge may be made for such material, *the renewal of which* would have been required for the repairs covered by the defect card, but such charge to be confined to the actual material stated on card. *Also, in case of items damaged which could have been repaired, labor charge may be made for such items on basis of labor for straightening or repairing same, but no labor charge is permitted for the R. & R. of any part and* no other labor shall be charged in such cases except insofar as labor is already included in the A. A. R. prices for material.

Reason: As a matter of equity. It is felt car owner is properly entitled to charge labor for straightening or repairing parts which are not damaged beyond repair.

Rule 98

The committee recommends that last sentence of present note following Interpretation No. 2 to this rule be relocated as a new Note 3 following Section (g) of same rule, and modified to read as follows:

Note 3.—Where A. A. R. Standard steel wheel gage indicates less than 2/16-in. service metal from full flange contour requirement, such wheel shall be considered as having full flange contour providing it does not require turning for other reasons.

Reason: To clarify the intent of the rule.

Rule 99

The committee recommends that first paragraph of this rule be modified as follows:

Proposed Form: Rule 99. In no case shall car owner be charged for *two or more* applications of journal bearings if applied within 30 days from initial application at same journal location on same road (etc.—no other change).

Reason: To clarify the intent.

Rule 101

The committee recommends that a new Item 58-B be added to this rule (present Item 58-B to be relocated as new Item 58-C), effective August 1, 1941, to read as follows:

58-B Brake pipe strainer (Pc. No. 502904), net.......... $1.08 (To be charged only when this new type strainer is applied in replacement of old style strainer).

Reason: Account change in Rule 60.

The committee recommends that a new Item 134-B be added to this rule, effective August 1, 1941, to read as follows:

134-B Coupler bottom rotary lock lift lever and toggle, riveted assembly, new, A. A. R. type E, single design, net .... $ 71 .. $ .02

Reason: Account change in Rule 17.

Rule 104

The committee recommends that Section (d) of this rule be modified as follows:

Proposed Form: (d) First application of A. A. R. Standard type "E" 6¼ by 8 in. shank coupler in place of A. A. R. Standard type "D" 6 by 8 in. shank coupler; or of A. A. R. Standard type "E" 5 by 7 in. shank coupler in place of A. A. R. Standard type "D" 5 by 7 in. shank coupler; or of A. A. R. Standard types "D" or "E" in place of former A. A. R. Standard or Temporary Standard couplers where such substitution *provides a total of 2½ in. minimum* side clearance for coupler shank without necessity of altering end of car or spacing of draft members; (etc.—no other change).

Reason: To eliminate confliction with A. A. R. Standard. It is also felt 2½ in. provides sufficient side clearance in such cases. This recommendation is concurred in by the Committee on Car Construction.

Rule 111

The committee recommends that allowance under Item 15 of this rule covering cleaning, lubricating and repairing AB freight brake equipment, be increased from *$7.28 to $7.99;* also, that a new sub-item (9) be added to Section (b) of Item 15 of this rule to read as follows; both changes to become effective August 1, 1941:

(9) Brake pipe strainer (piece No. 502904 or CV-232). To be charged only when this new type strainer is applied in replacement of old style strainer.

Reason: Account change in Rule 60.

Rule 112

The committee recommends that a new item be added to Section J of this rule (for which car owner may request return when cars are dismantled on foreign lines), effective August 1, 1941, to read:

AB brake equipment.

Reason: Car owner is reasonably entitled to return of serviceable AB brake equipment, if desired.

Rule 113

The committee recommends that first paragraph of this rule be modified, effective August 1, 1941, as follows:

Proposed Form: Rule 113. The settlement for a car when damaged or destroyed upon a private track shall be assumed by the railway company delivering the car upon such track; except in the case of a private car damaged or destroyed by or resulting from fire or explosion, or some other condition beyond the control of the delivering line, on private tracks belonging or leased to car owner *or lessee of car,* or while located on the private tracks of a car manufacturing or repair plant under arrangement between car owner and the car manufacturing or repair plant.

Reason: The present rule applies to both railroad and privately owned cars. It is inequitable to place responsibility upon delivering line for such damage when car is on private tracks belonging or leased to lessee of car.

The committee recommends that a new second paragraph be added to this rule, effective August 1, 1941, to read as follows:

When a car of private ownership is damaged or destroyed on the tracks of a road which is not a subscriber to the interchange Agreement of the Association of American Railroads, the subscriber road delivering the car to such non-subscriber road shall be responsible to the owner for damage to or destruction of the car while in possession of the non-subscriber, except where such car had been forwarded to the non-subscriber road by or upon authority of car owner or lessee.

Reason: For protection of car owner, in event car is delivered by a subscriber road to a non-subscriber road without authority of owner or lessee.

Rule 120

The committee recommends that first paragraph of Section (e) of this rule be modified, effective August 1, 1941, as follows:

Proposed Form: (e) If owner authorizes destruction, handling line shall allow credit for all material at A. A. R. scrap prices, less labor cost of destruction. However, owner shall have the privilege of having returned serviceable cast-steel truck side frames, metal truck and metal body bolsters, metal draft arms, friction draft gears, cast-steel yokes, metal ends, *"AB" brake equipment, auto loading devices,* and *refrigerator car circulating fans;* also *tanks,* special castings and valves of tank cars; by attaching to statement of estimated weights a list of such parts with full shipping instructions; such parts to be billed at A. A. R. scrap value plus *7 per cent* for handling, f. o. b. point of shipment.

Reason: Car owner is reasonably entitled to return of such serviceable parts if desired. Handling charge reduced to harmonize with present storehouse allowance.

Passenger-Car Rules

Rule 4

The committee recommends that the effective date of second paragraph of this rule, with reference to equipping all-steel or steel under-frame cars with cardboards or suitable receptacle for the accommodation of defect and joint evidence cards, now set at January 1, 1942, be extended to January 1, 1943.

Reason: The present situation justifies this extension.

Rule 7

The committee recommends that a new last paragraph be added to Section (e) of this rule (which lists owner's defects), to read as follows:

Failure of roller bearing units, or combination roller bearing and friction bearing units, due to defects or overheating.

Reason: Maintenance of roller bearings is generally performed by car owner. Handling line has practically no opportunity to protect itself against such failures. This recommendation has the concurrence of the Committee on Lubrication of Cars and Locomotives.

The committee recommends that a new first note be added to Section (j) of this rule, present Note to be located as Note 2 and modified, as follows:

(New) Note 1.—For each portion of Universal control valve removed from and for each portion applied to any car, the proper designating symbol as determined by the description shown below must appear on billing repair card.

Designating Symbol	*Description*
Eq. P. U-12	*Equalizing portion U-12—Without strainer cap.*
Eq. P U-12-C	*Equalizing portion U-12-C—With improved cylinder cap having hair strainer.*
QAP U-12	*Quick-action portion U-12—Without quick service or strainer, one ball check, body ¾ in. shorter than U-12-B portion.*
QAP U-12-B	*Quick-action portion U-12-B—With quick service and no strainer, two ball checks, body ¾ in. longer than U-12, vertical grooves on each side of body.*
QAP U-12-BD	*Quick-action portion U-12-BD—With quick service and same body as U-12-B and strainer bolted between body and high pressure cap.*

Proposed Form: Note 2.—When *equalizing portion U-12-C* is removed, it should be replaced in kind. If replaced *with equalizing portion* U-12, proper credit must be allowed car owner as outlined in notes following Item 20-C of Passenger Rule 21. In the substitution of *equalizing portion U-12-C* for *equalizing portion* U-12, car owner is not responsible for the betterment of improved cylinder cap unless the *equalizing portion U-12-C* valve is standard to *the* car as indicated by stenciling. The same principle applies when *the quick-action portion* U-12-BD *is substituted by or for quick-action portion U-12-B or quick-action portion U-12.*

Reason: To clarify the intent and simplify the preparation of repair cards. As recommended by the Committee on Brakes and Brake Equipment.

Rule 8

The committee recommends that Section (e) of this rule (which lists delivering line defects) be modified as follows:

Proposed Form: (e) Journal cut, or requiring reconditioning due to heating, on *friction bearing units;* axles bent; or axles damaged as provided in paragraph (a). When necessary to true up axles in cases of cut journals, if journal is reduced below the limit as prescribed in Rule 7 (e), axle must be changed at the expense of the delivering line.

Reason: Account change in Section (e) of Passenger Rule 7.

Rule 21

The committee recommends that second, third and fourth notes under Item 20-C of this rule be modified as follows:

Proposed Form: Note.—When *quick-action portion U-12* valve is removed and *quick-action portion* U-12-B valve applied, additional charge of $85.00 is proper versus car owner for betterment cost of converting. Likewise, when *quick-action portion* U-12-B is removed and *quick-action portion* U-12 valve applied, car owner must be allowed credit of $85.00. The quick-action or emergency portion of the U-12-B equipment can readily be distinguished from the U-12 type by its having two ball check caps on top of this portion instead of one cap as on the U-12 type; also, by having a vertical groove on each side of its body.

Note.—When *equalizing portion U-12-C* is removed and *equalizing portion U-12* applied, car owner must be allowed credit of $25.39.

Note.—When *quick-action portion* U-12-BD valve is removed, and *quick-action portion U-12-B* applied, car owner must be allowed credit of $23.30.

Reason: To clarify the intent and simplify the preparation of repair cards. As recommended by the Committee on Brakes and Brake Equipment.

The report was signed by J. P. Morris (chairman), general mechanical assistant, A. T. & S. F.; J. A. Deppe (vice-chairman), superintendent car department, C. M. St. P. & P.; W. H. Flynn, general superintendent motive power and rolling stock, N. Y. C.; L. Richardson, mechanical assistant to vice-president and general manager, B. & M.; G. E. McCoy, assistant general superintendent car equipment, Can. Nat'l; W. R. Elsey, general superintendent motive power, Pennsylvania; A. E. Smith, vice-president, Union Tank Car Company, and M. F. Covert, general superintendent of equipment, General American Transportation Corp.

The report was accepted.

Prices for Labor and Materials

In order that the rules may currently provide an equitable basis for inter-road billing, your committee has continued the work of analyzing material, labor and new equipment costs in A. A. R. Interchange Rules 101, 107, 111 and 112 of the Freight Car Code, and Rules 21 and 22 of the Passenger Car Code, with a view of determining and recommending necessary changes to be made in the next supplement to the current Code.

Rule 101

All miscellaneous material prices in Rule 101 were rechecked as of March 1, 1941, quotations submitted by the purchasing agents of the ten selected railroads, representing thirty-nine per cent of total freight car ownership in the United States and Canada, showing a slight upward trend in material markets as indicated by detail recommendations for revisions shown under this rule.

As announced in the 1940 report, a study was made through the Purchases and Stores Division, on 19 selected railroads representing all portions of the United States and Canada, covering the last six months of 1939, with respect to allowance for store expense used in the make-up of A. A. R. material prices. The result of this study showed a weighted average of the total store

expense for the nineteen railroads of 6.71 per cent; and, as result thereof, the 10 per cent allowance formerly used in computing A. A. R. material prices was reduced to 7 per cent effective January 1, 1941. Question having been raised as to whether the period studied was entirely representative, a further study is under way on the same railroads covering the entire year of 1940. If further modification is found necessary as result of this extended study, revision will be made and included in the rules effective January 1, 1942.

The penalty price for the former standard pressed-steel box lid has been abrogated, and new price is recommended on basis of current market quotations. The former specification lid continues in use to a considerable extent and is considered satisfactory in service by a number of railroads. In view of this situation, it is felt the lid should stand on its merits insofar as A. A. R. material price is concerned.

Item 105-B has been clarified to definitely indicate the allowance includes material for lumber.

Item 188-D is modified to provide additional material charge for doors constructed wholly or in part of high-tensile steel.

Recommendation is made that the average credit allowance for the No. 2 brake beam in Item 210 be reduced to scrap value, with corresponding reduction in the new and secondhand prices. Few railroads are reclaiming this type of beam and the parts cannot be used in reclamation of No. 2-plus or No. 15 brake beams. This recommendation has the concurrence of the Arbitration Committee and the Committee on Brakes and Brake Equipment.

Rule 107

As stated in the 1940 supplementary report, your committee conducted time studies in the field of a considerable number of additional labor operations and, where adjustments were found necessary, modifications were made in the rules effective January 1, 1941.

New note added to Item 22 to clarify the intent with respect to charge for brake hanger renewed in connection with R. & R. or R. of wheels, bolsters and truck sides.

First note following Item 48 modified to eliminate confliction with note following Item 45.

Third note following Item 126 modified to clarify the intent.

Items 142 and 143 modified and new third note added to Item 143, to clarify the intent that allowances for application of running boards in Items 138 to 143, inclusive, apply to covered hopper cars as well as house cars.

New Item 323-A added and Item 325 modified, to eliminate confliction between Items 267, 323 and 325.

Rule 111

New note added to Item 13, to clarify the intent that the charge includes all labor and material for triple-valve parts, except material for triple-valve body.

Rule 112

Recommendations are made in this rule respecting reproduction pound prices of new freight cars of all classes, in order that Supplement of August 1, 1941, may reflect 1940 costs in lieu of figures shown in the present Code. New prices recommended are based on costs of 41,279 freight cars constructed during the year 1940.

Passenger Car Rule 21

Items 10 and 11 modified to include reference to "express" and "combination mail and express" cars. Third and fourth operations listed under Item 20-C modified to clarify.

Passenger Car Rule 22

Material prices were rechecked on basis of quotations as of March 1, 1941, showing a slight upward trend on a few items as indicated by detail recommendations for revisions shown under this rule.

Item 49 and note following modified to provide charge for service metal in excess of 27/16 in. on wheels of nominal 36 in. diameter.

It is the intent of the committee to investigate labor and material costs again in October and if sufficient change develops, necessary revisions will be made and inserted in the Rules effective January 1, 1942.

[The changes recommended in the existing rules are shown in detail in the report.—Editor.]

The report was signed by A. E. Calkins (chairman), superintendent of equipment, N. Y. C.; A. E. Smith (vice-chairman), vice-president, Union Tank Car Company; J. D. Rezner, general car foreman, C. B. & Q.; P. Kass, superintendent car department, C. R. I. & P.; T. J. Boring, general foreman, M. C. B. Clearing House, Pennsylvania; H. H. Boyd, assistant chief motive power and rolling stock, C. P.; and A. H. Gaebler, superintendent car department, General American Transportation Corporation.

The report was accepted.

Report on Tank Cars

During the past year the committee considered a total of 421 dockets and applications for approval of designs as follows: 278 applications covered designs, materials and construction of 5,617 new shipping containers, for mounting on new cars or for replacement on existing cars.

Six applications covered 12 multiple-unit cars to be used for the transportation of 15 Class I. C. C.-106-A-500 one-ton containers. One application covered one new car structure on which would be mounted a reconditioned tank. One hundred and one applications covered alterations in, additions to or conversions and reconditioning of 1,147 existing tank cars or shipping containers.

Thirty-four applications requested approval of tank-car appurtenance designs, without reference to specific cars.

I. C. C. Specifications for Welded Tank-Car Tanks

Recommendations, previously made to the Interstate Commerce Commission, covering a general revision of the commission's specifications for riveted and forge-welded tank-car tanks to be mounted on or to form part of a car were considered at public hearing held in Washington, D. C., on August 8, 1940. By Order, dated August 16, 1940, the commission made effective January 7, 1941, revised specifications as recommended by your committee.

At public hearings before the Interstate Commerce Commission, during September, 1934, your committee recommended the adoption of specifications, then presented, for tank-car tanks fabricated by means of fusion welding. Recommendation was also made that authority be granted for the use of such tanks, for the transportation of articles classed as dangerous.

To obtain experience with respect to the suitability of tank-car tanks fabricated by means of fusion-welding for the transportation of dangerous articles, the commission, following the September, 1934, hearings and to satisfy specific requests, authorized a total of 1,085 such tanks for use in experimental service trials. The commission's several authorities required owners or operators of any tanks so built and placed in service to render periodic reports covering their condition as determined by inspection.

At the August 8, 1940, hearings, your committee reiterated its 1934 recommendation and supplemented this by report that, of the 1,085 tanks authorized, 491 had been constructed and placed in service. Further, these latter, during 18,047 trips, had traversed a total of 15,292,789 miles without failure of any fusion-welded seam.

With this experience record to sustain it, the commission, by its Order of August 16, 1940, incorporates in its revised regulations, effective January 7, 1941, specifications, as recommended by your committee, for fusion-welded tank-car tanks. Authority is also granted for the use of these in substitution for comparable riveted or forge-welded tanks in the transportation of dangerous articles.

A. A. R. Specifications for Tank Cars

Revision of Interstate Commerce Commission specifications for tanks to be mounted on or to form part of a car, as outlined in the foregoing, has necessitated a general revision of the A. A. R. specifications for tank cars. Distribution of copies of these revised specifications will shortly be made to all interested parties.

As indicated by your committee's last previous report, Ap-

pendix A to United States Safety Appliances hand book, last revised during 1920, lacks requirements for appliances now installed on tank cars to meet demands of shippers and their customers. To overcome this deficiency a proposed Appendix B is being formulated. While all items of the latter have not been disposed of, your committee reports progress.

The report was signed by F. Zeleny (chairman), engineer of tests, C. B. & Q.; W. C. Lindner (vice-chairman), chief car inspector, Pennsylvania; G. S. Goodwin, mechanical engineer, C. R. I. & P.; A. G. Trumbull, chief mechanical engineer, C. & O.; B. M. Brown, assistant general superintendent motive power, Sou. Pac.; R. D. Bryan, engineer car construction, A. T. & S. F.; G. A. Young, professor of mechanical engineering, Purdue University; A. E. Smith, vice-president, Union Tank Car Company; W. C. Steffa, transportation manager, Sinclair Refining Company; R. T. Baldwin, secretary, The Chlorine Institute, Inc.; H. J. Groneméyer, supervisor car equipment, E. I. du Pont de Nemours & Company, Inc.; and R. W. Thomas, manager, special products department, Phillips Petroleum Company.

The report was accepted.

Report on Loading Rules

The annual report of the Committee on Loading Rules for the year 1941 is more condensed than in the past for the reason that it is no longer necessary to submit the recommendations of the committee to letter ballot, this permitting the publishing of supplements to the loading rules in advance of the annual meeting. This is a distinct advantage to both railroads and shippers.

The numerous changes and additions made in the last year were necessitated by the rapid changes being made in the shipper's methods of loading, increased speed in train handling and the growing need for new figures covering commodities not previously contained in the rules. All of the approved methods contained in both Supplements Nos. 1 and 2 to the current rules were adopted only after being followed as experimental loads and their value determined.

During the past year, meetings were held with the steel fabrication shippers, creosote pole shippers, rail shippers, farm equipment shippers, cast iron pipe shippers, wrought iron pipe shippers, as well as our annual meeting with representatives of the steel industry. In all, a total of 43 such meetings were held during the year.

Included in this report, as Appendix A, was a summary of the disarranged load reports received from carriers during the six months period ended December 31, 1940. While the summary indicates an increased number of reports received over the first six months of 1940, there are still a number of carriers who are not reporting failures, and a still greater number who are only reporting a small percentage of them. A report similar to that which is shown on Page 2 of Supplement No. 1 of the Loading Rules should be prepared for every open top load which requires adjustment enroute. The summary showing the loads which were disarranged either in "Train Handling," "Yard Switching" or "When received in Interchange," clearly indicates the need for closer inspection on the part of the mechanical department at originating points and enroute, as well as more care on the part of the transportation department in the handling in trains and in the yards.

In connection with the National Defense Program, the committee was instructed last November, to formulate a code of rules for the loading of mechanized and motorized units and major calibre guns for the United States Army and Navy. This necessitated a number of conferences by designated members of the committee with army officers at posts in the Mid-West, South and in the East. It was necessary to secure information and measurements to enable them to prepare specifications and drawings to cover the various units to be loaded on open top equipment. A special supplement containing a set of general rules, specifications and 23 drawings has since been submitted to the War Department at Washington, approved, published and distributed to all army posts and to the carriers. Having in mind that loading methods which would require the use of special tools, a number of various sizes of lumber, bolts, rods, etc., would not be desirable when loading for combat movement, the committee standardized on blocking insofar as possible, eliminating the necessity for using rods, bolts, etc., and prepared the rules in such a manner that only tools common to all army posts are required for loading. A train of army equipment was blocked in accordance with the proposed methods at Fort Knox, Kentucky, and subjected to unusual handling conditions without any disarrangement of lading or securement. The units forwarded from Fort Knox to Washington for the inaugural parade were loaded in a like manner and no trouble was experienced in either direction.

[The details of changes in General Rules Nos. 4, 5, 9, 15, 16, 18 and 21 which were not included in the last annual report but are now effective, having been published in Supplements Nos. 1 and 2 were included in the report.—EDITOR]

The report was signed by W. B. Moir (chairman), chief car inspector, Pennsylvania; C. J. Nelson (vice-chairman), superintendent interchange, Chicago Car Interchange Bureau; R. H. Dyer, general car inspector, N. & W.; H. S. Keppelman, superintendent car department, Reading; T. W. Carr, superintendent rolling stock, P. & L. E.; A. H. Keys, district master car builder, B. & O.; H. H. Golden, supervisor, A. A. R. Interchange and Accounting, L. & N.; H. T. DeVore, chief interchange inspector, Youngstown Car Inspection Association; H. J. Oliver, general car inspector, D. T. & I., and F. G. Moody, master car builder, Nor. Pac.

Discussion

A member, referring to the general rule in the special supplement containing rules governing the loading of mechanized and motorized army equipment which stated that cars loaded in accordance with these specifications must not be handled in hump switching, thought that this particular rule penalized the railroad. Chairman Moir stated this rule was included as a precautionary measure only in order to prevent damage to equipment such as artillery caused by the impact of cars coupling at a speed of eight to ten miles an hour.

The report was accepted.

Report on Wheels

Through the courtesy of the Association of Manufacturers of Chilled Car Wheels, your committee has been furnished a list of the commercial manufacturers of cast-iron wheels that are subject to the association's recommended practices and inspection.

It is gratifying to note all the commercial wheel plants with the exception of two manufacturers in the states and two in Canada are taking advantage of the facilities offered through the association for developing an improved wheel product.

Grinding of Cast-Iron Wheels

As more attention is given to grinding of cast iron wheels it is desirable that recommendation be made as to some means by which the wheel-shop forces can identify wheels suitable for the grinding process without reducing the chill portion of the tread beyond serviceable limits.

In recognition of this requirement, your committee has outlined methods of procedure presented as Appendix A. In this recommendation, two methods are suggested; one refers to the relationship of tape sizes to available service metal while the second, or alternate, is confined to measurements as established by a modification of the tread-worn-hollow remount gage. In the application of this gage, two suggestions are made; one relates to removing 1/16-in. from the end of the projection on the gage, the other suggests that the standard gage may be used by applying a 1/8-in. liner under the surface that contacts the crest of the flange.

If experience with these two processes confirms the opinion of the committee that this is a reliable means for the selection of wheels for grinding, then the methods as outlined in Appendix A should be inserted in the Wheel and Axle Manual.

Request has come from a member road that manufactures a portion of its own cast-iron wheels, asking if it would be acceptable to show the road's initials and place of manufacture as a means of identification for such wheels.

The committee sees no reason why such a procedure is not satisfactory so long as the abbreviations used would not be confused with any existing markings.

In the 1939 report there was submitted a statement regarding the determination of chill by instrumental methods. Further investigation along this line indicated that additional studies would have to be made before it would be consistent to make any definite recommendations.

Your committee has been advised by the Association of Manufacturers of Chilled Car Wheels that it has found the instrumental measurement of chill is not only practical, but is the most reliable means of determining this condition. The committee solicited a comment from the A. M. of C. C. W. on this subject, an abstract of which follows.

Determination of Chill Depth by Instrumental Hardness

Several years ago, the chilled wheel industry began to experiment with the use of instrumental chill determination in an effort to obtain more reliable chill measurement. A number of worn through chilled wheels were given a careful examination in order to get the exact physical and chemical characteristics of the chill that was wearable and also chill that had been accepted as wearable, but had failed to perform satisfactorily in service.

It is generally known that hardness values in iron can be directly related to combined carbon contents, and in this case it was found that areas in worn through chilled wheels invariably contained free carbon in excess of one-half of one per cent. It was also found that when this amount of free carbon was present, the hardness would be less than 55 Scleroscope or 363 Brinell.

This then formed the basis for setting up the first instrumental limits, which were included in A. M. C. C. W. specifications. In the beginning, our Chicago headquarters acted as a referee in questionable cases, and when samples were sent in for check, it was the practice to determine the hardness with a Brinell, Scleroscope, and Rockwell and in addition, obtain chemical analysis for total and free carbon every ⅛ in. from the surface of the tread through the limit of wear.

A basis for arriving at maximum instrumental limits is not quite as simple as for the minimum. With low chill we are concerned with wear, whereas high chill involves strength. However, we know where the most vulnerable points are, and here again physical values bear a direct relation to combined carbon.

It is the safe limits for these physical values that instrumental chill measurement is intended to determine.

The first instrumental limits recommended and accepted by our Association have not proven entirely satisfactory. This was not unexpected, but the principle is right, and further experience is perfecting the method to the extent that in the near future all questionable chill will be accepted or rejected by instrument.

There are 20 odd manufacturing companies in the chilled wheel association, and in the beginning, the various companies preferred different types of instrumental machines. Since the inspection is handled by association inspectors, this meant that the specifications must include provisions for each type of machine. At the last committee meeting, a recommendation was made to the industry that it standardize on the Brinell, and this was subsequently approved.

Revised instrumental limits for chill determinations are now included in the A. M. C. C. W. specifications for actual practice. These became effective June 1, 1941. It is hoped that the railroad inspectors will avail themselves of the opportunity to examine the set-up for instrumental testing in all plants from which they purchase wheels.

Identification of Single-Plate Bracketed-Type Wheels

To provide means for identifying single-plate bracketed-type cast-iron wheels from single-plate wheels and in consideration of the advantage this identification marking may be in accumulating data as to the service record of the two types of wheels your committee has recommended to the Arbitration Committee that a symbol be provided for the identification of the single-plate bracketed-type wheel. The single-plate wheel is now identified by the symbol SP. The single-plate bracketed type wheel could be identified by the symbol SPB.

Effect of Cored Hub on Axle Strength

In the 1940 report, reference was made to a test in contemplation to develop the possible influence the coring of the hub would have upon the strength of the axle.

There is no additional information along this line available, but the committee is still carrying the subject in the open docket. Unless some means are provided for accelerated laboratory tests to develop information as to the influence the coring of the hub has upon service of the axle, the rate of development for such information will be extremely slow. The committee earnestly solicits any information that may develop on roads where cored-hub wheels have been applied.

Specifications for Heat-Treated Multiple-Wear Wrought Carbon-Steel Wheels

It has been brought to your committee's attention that Specification M-123-40—Sec. VI-Marking, Par. 12 (a) mentions the AAR-MW marking preceding the other markings specified on the back face of the rim. This arrangement is different from the way the marking paragraph is expressed for multiple-wear, two-wear and one-wear wrought steel wheels where the A. A. R. and wheel-type identifications follow the other identification markings.

Since this difference in arrangement has resulted in a technical question being raised by some material inspectors, your committee has recommended an editorial change made in Specification M-123-40—Sec. VI-Marking, Par. 12 (a) to conform with the similar paragraph in the other wrought-steel wheel specifications wherein the A. A. R. and wheel type identifications follow the other identification markings.

Influence of Contour upon Service of One-Wear Wrought-Steel Wheels

Information has reached your committee that certain private car lines have been investigating the influence of tread contour upon the service of one-wear wrought-steel wheels. The contour change under observation is a deviation from the present standard of 1-in-20 straight taper in favor of the 1-in-20 taper with the outside tread chamfered similar to the cast iron wheel tread contour.

Encouraging reports have been current with respect to these observations and your committee is endeavoring to secure direct information regarding this contour influence. It is the hope during the coming year to collect more substantial data along this line for presentation in its 1942 report.

Wrought-Steel Wheels for Axles with Enlarged Wheel Seats

The committee's 1940 report included two Tables, A-1 and A-2, as recommended by the Technical Board of the Wrought Steel Wheel Industry, giving the general dimensions of wrought steel wheels for use on A. A. R. axles with enlarged wheel seats.

The committee on Locomotive Construction has made certain revisions in Table A-2 covering wheels for Diesel-electric locomotives and are presenting it for adoption as standard practice in their report for 1941. Your committee concurs in this recommendation.

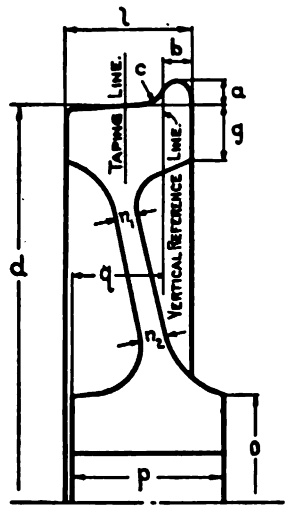
In the case of Table A-1 showing multiple-wear wrought-steel wheels for freight cars, passenger cars and locomotive tenders, the point has been raised that the table as presented in last year's report does not take care of wheels with rims thicker than the nominal 2½ in. as shown. For this reason Table A-1 has been revised to take care of this factor. It has also been amplified to include all tolerances.

Machining One-Wear Wrought-Steel Wheels

There is an opportunity to restore for further service one-wear wrought-steel wheels removed for slid flat, built-up tread, out-of-roundness or similar conditions by either grinding or machining.

On one-wear wrought-steel wheels, especially those manufactured since 1935, with increased flange thickness, when removed on account of worn condition of the flange may be restored to further service with a minimum loss of service metal if the wheels are machined to the multiple-wear contour instead of attempting to maintain the one-wear wrought-steel wheel con-

MULTIPLE WEAR WROUGHT STEEL WHEELS



* MIN. HUB WALL $1\frac{1}{4}$".

** MIN. HUB WALL $1\frac{1}{2}$".

*** STANDARD WHEELS HAVE DIAMETERS AS SHOWN IN THE TABLE WITH RIMS $2\frac{1}{2}$" THICK.

IF RIM 3" THICK IS USED THE METAL IS ADDED ON THE OUTSIDE MAKING THE ACTUAL MINIMUM DIAMETERS 34, 37, 39, 41, 43".

DIMENSIONS WITH TOLERANCES.

AXLE CLASS	$4\frac{1}{4}$"×8", 5"×9", $5\frac{1}{2}$"×10"	6"×11", $6\frac{1}{2}$"×12"	$4\frac{1}{4}$"×8", 5"×9", $5\frac{1}{2}$"×10"	6"×11", $6\frac{1}{2}$"×12"	7"×13", $7\frac{1}{2}$"×14"	6"×11", $6\frac{1}{2}$"×12"	7"×13", $7\frac{1}{2}$"×14"	6"×11", $6\frac{1}{2}$"×12"	7"×13", $7\frac{1}{2}$"×14"	6"×11", $6\frac{1}{2}$"×12"	7"×13", $7\frac{1}{2}$"×14"
WHEEL CLASS	33G	33H	36C	36D	36E	38A	38B	40A	40B	42A	42B
a	1" $+\frac{1}{16}$" -0"	SAME	SAME	SAME	SAME	SAME	SAME	SAME	SAME	SAME	SAME
b	$1\frac{5}{32}$" $+\frac{1}{16}$" -0"	SAME	SAME	SAME	SAME	SAME	SAME	SAME	SAME	SAME	SAME
c	$\frac{11}{16}$" $+\frac{1}{16}$" $-\frac{1}{16}$"	SAME	SAME	SAME	SAME	SAME	SAME	SAME	SAME	SAME	SAME
*** d	33" +14 TAPES -0	33" +14 TAPES -0	36" +14 TAPES -0	36" +14 TAPE -0	36" +14 TAPES -0	38" +14 TAPES -0	38" +14 TAPES -0	40" +14 TAPES -0	40" +14 TAPES -0	42" +14 TAPES -0	42" +14 TAPES -0
*** g	$2\frac{1}{2}$" MIN. 3" MIN.	SAME	SAME	SAME	SAME	SAME	SAME	SAME	SAME	SAME	SAME
l	$5\frac{1}{2}$" $+\frac{1}{8}$" $-\frac{1}{8}$"	SAME	SAME	SAME	SAME	SAME	SAME	SAME	SAME	SAME	SAME
n_1	$\frac{3}{4}$" MIN.	$\frac{3}{4}$" MIN.	$\frac{3}{4}$" MIN.	$\frac{3}{4}$" MIN.	$\frac{3}{4}$" MIN.	$\frac{7}{8}$" MIN.	$\frac{7}{8}$" MIN.	$\frac{7}{8}$" MIN.	$\frac{7}{8}$" MIN.	1" MIN.	1" MIN.
n_2	1" MIN.	1" MIN.	1" MIN.	1" MIN.	1" MIN.	$1\frac{1}{8}$" MIN.	$1\frac{1}{8}$" MIN.	$1\frac{1}{8}$" MIN.	$1\frac{1}{8}$" MIN.	$1\frac{1}{4}$" MIN.	$1\frac{1}{4}$" MIN.
o	* 11"	* 12"	* 11"	* 12"	** $13\frac{1}{2}$"	* 12"	** $13\frac{1}{2}$"	* 12"	** $13\frac{1}{2}$"	* 12"	** $13\frac{1}{2}$"
p	7" $+\frac{1}{8}$" $-\frac{1}{8}$"	$7\frac{1}{2}$" $+\frac{1}{8}$" $-\frac{1}{8}$"	7" $+\frac{1}{8}$" $-\frac{1}{8}$"	$7\frac{1}{2}$" $+\frac{1}{8}$" $-\frac{1}{8}$"	SAME	SAME	SAME	SAME	SAME	SAME	SAME
q	$3\frac{13}{32}$" $+0$" $-\frac{1}{8}$"	$3\frac{5}{32}$" $+0$" $-\frac{1}{8}$"	$3\frac{13}{32}$" $+0$" $-\frac{1}{8}$"	$3\frac{5}{32}$" $+0$" $-\frac{1}{8}$"	SAME	SAME	SAME	SAME	SAME	SAME	SAME

Dimensions and tolerances of multiple wear wrought steel wheels

tour. Wheels so machined are suitable for service without further disturbance if the spacing back to back of rim is not less than the prescribed limit of 53 in.

Your committee has a sub-committee studying this proposition jointly with a sub-committee of the Arbitration Committee, which joint committee is taking into consideration the physical limits and interchange accounting. The joint committee is not in a position at the time of the preparation of the report to make recommendations, but this subject will be continued on docket with the purpose of having this proposition satisfactorily worked out for inclusion in the 1942 report.

The possibility of using existing wheels for mounting on the new design axle with enlarged wheel seat is still being studied and while there is not sufficient information to make definite recommendations at this time, the results so far indicate that this procedure is going to be possible within reasonable limits.

Matching Wrought-Steel Wheels to Within Variation of one Inch in Diameter in the Same Truck

Upon a request from the Car Construction Committee to revise Par. 162 in the Wheel and Axle Manual, recommending that the difference in the tread diameter between two pairs of wheels in any one truck should not exceed one inch, the Wheel Committee recommends that Par. 162 of the Wheel and Axle Manual be revised as follows: *Proposed.*—All wheels in one truck should be as nearly equal in tape size as the stock on hand permits. *In no case should the difference in tread diameters between different pairs of wheels in one truck exceed one inch except where other means are provided for leveling the truck.*

Revision of Par. 124—Spacing of Rails on Storage Tracks

A member road has recommended that consideration be given to the revision of Paragraph 124—Page 145 of the Wheel and Axle Manual with relation to the spacing of rails on storage tracks and the grouping of wheels of widely varying diameters in order that the flange of one-wear wheel might not nick the axle of an adjacent wheel.

In conformity with this request, the Committee recommends that Paragraph 124 of the Wheel and Axle Manual be revised as follows: *Proposed.*—Storage tracks should be spaced so that the flanges of one pair of wheels cannot strike either the journal or the center portion of the adjacent axle. A nick in the journal may cause a hot box and a nick in the center portion of the axle may lead to breakage. Spacing pairs of rails 6 in. on centers will prevent this nicking as the flanges will then strike the black collar behind the wheel seat of the next axle.

To prevent axles and flanges contacting on wheels of different nominal diameters or on multiple-wear wheels when placed on storage tracks, such wheels should also be segregated so that those having widely varying diameters are not stored together. For example, 33-in. nominal diameter wheels should not be stored with 36-in. diameter wheels. Multiple-wear wheels of the same nominal diameter should be further segregated so that those having rim thicknesses 1¼ in. or more, are stored separately from those having rim thicknesses less than 1¼ in.

Revision of Paragraph 35—Thermal Cracks

Your committee is of the opinion that possibly, serviceable wheels are being discarded on account of developing thermal

cracks. It is recognized that the service condition to which wheels are subjected, where thermal cracks are developed, must govern the procedure to be followed in the handling of such wheels and the Committee does not undertake to recommend a procedure that might cover all conditions where thermal cracks occur.

The committee believes, that generally speaking, wheels developing minor thermal cracks can be reused by turning out such cracks and in this connection it is recommended that recognition be given to this procedure by adding Par. (d) to Par. 35 of the Wheel and Axle Manual to read as follows:

Thermal cracks can be removed by machining and when completely removed the wheels can be again used. When setting up the wheels in the lathe, it is good practice to mark the longest thermal crack with a piece of crayon on front and back face of rim at location of this crack, then proceed with the rough cut until all evidence of the crack has been removed. Then examine the entire tread to note that positively all cracks have been removed, after which a finish cut shall be taken and the wheel put back in service.

Wheel-Shop Practices

In each year's annual report your committee has taken the opportunity to stress the importance of improvement in wheel-shop practices and in its fall 1940 meeting, definite recommendation was made along this line in the form of a request to the General Committee suggesting that funds be appropriated to provide for qualified A. A. R. inspectors to make an inspection of wheel-shop facilities and practices in both railroad shops and car builders plants to determine whether the plants are following the Association's recommendations for handling wheels as outlined in the Wheel and Axle Manual.

The General Committee in passing upon the subject, referred it back to the Wheel Committee instructing the committee to prepare recommendations as to the wheel shop-practices that should be considered mandatory in preparing wheels to be used in interchange service.

Your committee has given careful consideration to the recommendation of the General Committee and is presenting as Appendix B, recommendations relating to wheel-shop practices that should be submitted to the association for adoption as standard practice, with further recommendation that the Arbitration Committee provide the necessary revision in the rules of interchange to make these standard practices mandatory for wheels prepared for interchange service.

Summary of Recommendations—1941

To Be Considered by Arbitration Committee

1—Provide a symbol for identifying in interchange single plate bracketed type wheels.

2—Revise section (i) of Rule 98 by the addition as recommended in the report.

For Revision in Wheel and Axle Manual to Be Submitted to Letter Ballot

1—Revision of Par. 323 relating to the identification marking for ground cast iron wheels.

2—Revision of Par. 162 relating to matching wheels to within a variation of 1 in. in diameter in the same truck.

3—Revision of Par. 124 relating to the spacing of rails for wheel storage tracks.

4—Revision of Par. 35 relating to thermal cracks in wrought steel wheels. It is recommended that a definite code of rules to govern Wheel Shop Practices as outlined in Appendix B be submitted to letter ballot and adopted as standard and this code of rules be enforced through interchange rule agreement.

5—It is recommended that the notes under wrought steel wheel defect symbols be revised as recommended in the report.

The report was signed by H. W. Coddington (chairman), research and test engineer, N. & W.; D. Wood (vice-chairman), engineer of tests, Sou. Pac.; E. E. Chapman, mechanical assistant, A. T. & S. F.; W. R. Hedeman, engineer of tests, B. & O.; J. Matthes, chief car inspector, Wabash; A. M. Johnsen, engineer of tests, Pullman Company; E. C. Hardy, assistant engineer, N. Y. C.; A. G. Hoppe, assistant mechanical engineer, C. M. St. P. & P.; H. H. Haupt, general superintendent motive power, Central Region, Pennsylvania, and C B. Bryant, engineer of tests, Southern.

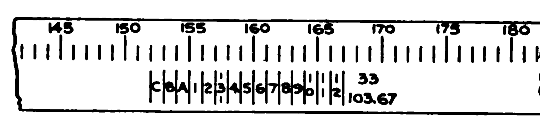
Appendix A—Recommended Practices for Grinding Slid-Flat Chilled Car Wheels

The limit of grinding or reduction in circumference is governed by the amount of metal which will remain for wear before the wheel will be condemned by the A. A. R. tread-worn-hollow gage. Grinding should not be carried beyond the point where the remaining wearing metal will be less than one-half that of a new wheel. This limit is equivalent to a final tape size which is 10 tape sizes (see Fig. 1) less than the original tape size of the wheel. The depth of chill in wheels of all original tape sizes is adequate to permit this without impairment of service. The following tables define this limitation:

New circumference		Maximum allowable reduction on circumference—linear no.	Minimum allowable ground circumference—linear no.
Tape size—permanent marking	Linear no.—circumference measurement		
1 (10-15)	155	10	145
2 (20-25)	156	10	146
3 (30-35)	157	10	147
4 (40-45)	158	10	148
5 (50)	159	10	149

Length of flat spot, in.	Reduction in circumference required to remove flat spots, linear no.
2	1
2¼	2
2½	2
2¾	3
3	3
3¼	4
3½	4
3¾	5
4	6
4¼	7
4½	8
4¾	9
5	10

Example: A pair of slid-flat wheels are set out for grinding. The wheels were tape 4 when new (linear No. 158), the worn circumference is 155 and the longest of the two flat spots is 3 in. Removal of a 3-in. flat spot reduces the circumference 3 linear numbers. The worn circumference is 155, which will thus be reduced to 152. The minimum allowable ground circumference of a tape 4 wheel is 148 and as removal of the flat spots will not reduce the circumference below that point, grinding is justified. If this flat spot had been 4½ in. long, the required reduction in circumference would then be 8 linear numbers, bringing the



A.A.R. CAR WHEEL CIRCUMFERENCE GAGE

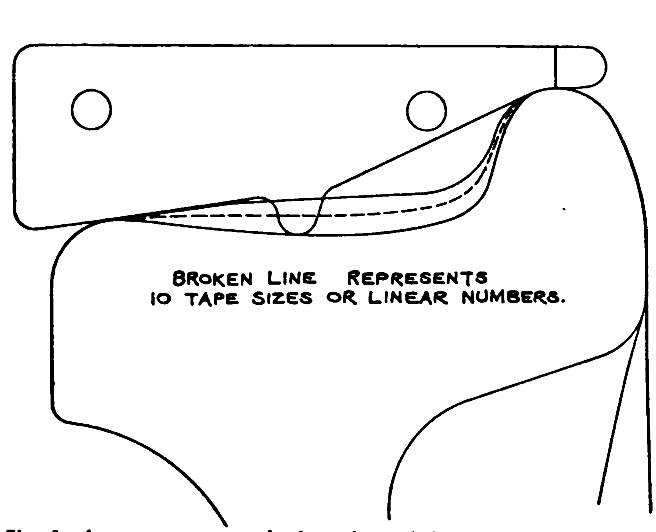


Fig. 1—Average wear on wheel condemned for tread worn hollow—Space between lines 157 and 158 on the upper side of the tape coincides with space representing tape size No. 3 and 3.5 for 33-in. cast-iron wheels

ground circumference to 147, which is below the minimum limit for a tape 4 wheel.

Alternate Method

The A. A. R. tread-worn-hollow gage condemns a wheel for tread wear when practically 3/8 in. is worn off the tread at a point approximately 2½ in. from the crest of the flange. Grinding is justified when the wearable metal below the center of the slid flat spot is 3/16 in. or more. The suitability of the wheel for the grinding operations can be determined by gage measurements and two methods have been suggested for taking this dimension.

The first method is by taking the A. A. R. tread-worn-hollow remount gage and removing 1/16 in. from the projection.

The second method is by taking the same A. A. R. remount gage and without altering the length of the projection, and making it adaptable for this determination by applying a 1/8-in. liner to the surface that contacts the crest of the flange. This liner can be held in place by spring clips.

The first method is illustrated in Fig. 2, upper sketch, and the second in Fig. 2, lower sketch. With either type of gage the application is made at the deepest part of the slid-flat spot and grinding is justified when the point of the gage contacts the wheel tread in the lowest point.

Ready Reference Table for Determining Whether Grinding is Permissible

Linear circumference of worn wheel	Original tape size of wheel -1- 10-15	-2- 20-25	-3- 30-35	-4- 40-45	-5- 50
	Max. length of flat spot permissible to grind, in.				
159	...	...	...	...	5
158	...	...	...	5	4¾
157	...	...	5	4¾	4½
156	...	5	4¾	4½	4¼
155	5	4¾	4½	4¼	4
154	4¾	4½	4¼	3¾	3½
153	4½	4¼	4	3½	3¼
152	4¼	3¾	3½	3¼	2¾
151	4	3½	3¼	2¾	2½
150	3½	3¼	2¾	2¼	...
149	3¼	2¾	2½	...	...
148	2¾	2¼	...	...	...
147	2½	...	...	...	...

Note: Adjoining flat spots less than 2½ in. are judged on the basis of the longer one.

Appendix B—Rules Governing Wheel-Shop Practice

Boring Mill Practice

(a) Boring mills must be maintained with the table running true and with the boring bar held true with respect to the center and plane of the table and without chatter.

(b) Chuck jaws must be properly aligned radially, together with vertical alignment, and contour may have a taper of 1 in 20, to correspond to the wheel tread line, or be maintained vertical.

(c) The bearing points of the chuck jaws must be maintained in one plane at right angles to the axis of the boring bar and truly concentric with it.

(d) Boring mills must be inspected and checked once each week when they are in constant use, and any time that any irregularity is discovered in turning or mounting wheels, and proper repairs made, when necessary, to insure accurate boring of wheels.

(e) The boring bar must have a positive micrometer adjustment for the cutters, accurate to 0.001 in.

(f) If separate roughing and finishing cutters are carried on the boring bar at the same time, they must be separated by a distance greater than the length of the hub.

(g) Boring-bar cutters shown in Figs. 102-A, B and C, Wheel and Axle Manual, or equivalent, must be used.

(h) With wheel properly aligned in position on the mill with regards to concentricity and to plane, the metal removed from the bore of new wheels must be made by two or more separate cuts; i. e., one or more roughing and one finishing. A radius or chamfer of approximately 1/8 in. must be turned at the entry or back end of the hub, to be made after the finishing cut.

The finished wheel bore must be within the limits for rotundity and taper and must be smooth and concentric with the tread.

(i) Inside and outside micrometer calipers are necessary for measurement of wheel bores and axle wheel seats to insure consistent results. Each wheel bore and axle wheel must be checked at not less than three points in its length and on two different diameters at each of these points to insure rotundity and absence of taper. The variation for any two of these measurements shall not exceed 0.002 in.

The bore should be smaller than the wheel-seat diameter, with a tolerance of 0.001 in. per inch of diameter of wheel seat for wrought-steel wheels. For cast-iron wheels the tolerance should be equivalent to 0.0015 in. per inch of wheel seat diameter, and a maximum of 0.012 in. smaller bore than the wheel seat diameter.

Care must be taken to secure the greatest value from the metal in both wheel seat and hub bore (see Fig. 105, Economical Selection of Wheels and Axles, Wheel and Axle Manual).

Axle-Lathe Practice

(a) Axle lathes must be maintained so that the lathe centers are in alignment, wear between the ways and tool carriages must be taken up, so that machining of axles may be done truly concentric and without taper or chatter. Spindle bearings, etc., must be renewed when necessary, to insure accurate turning.

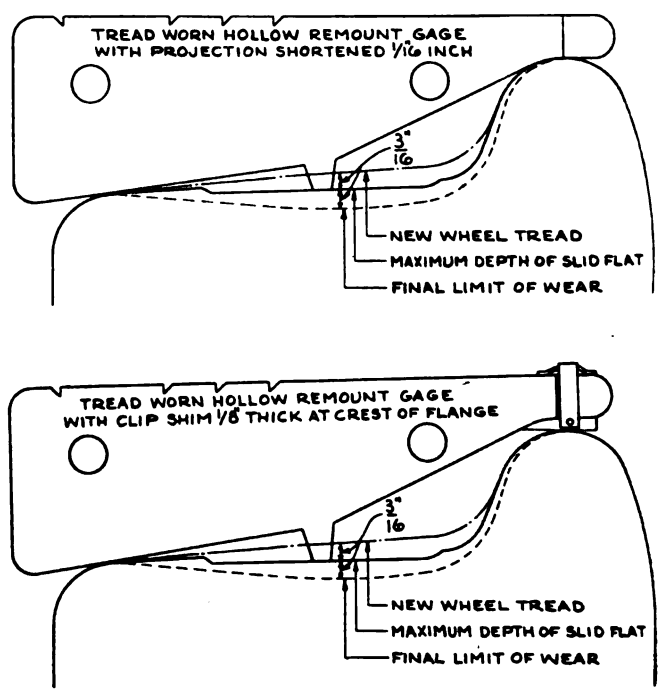


Fig. 2—Gages for checking slid-flat cast-iron wheels for grinding

Lathe centers must be reground or renewed when they show signs of wear.

Axle lathes must be inspected and checked once each week when they are in constant use, and at any time that any irregularity is discovered in mounting wheels, and proper repairs made when necessary.

(b) Lathe tools used for roughing and finishing cuts on collars, journals and wheel seats should have an edge approximately 1¼ in. wide and absolutely straight except for a 1/8 in. radius on one side for cutting the end collar fillet and suitable radius at the other side for cutting the back or dust guard fillet. Sufficient undercurrent clearance should be provided. Separate tools must be used for the roughing and finishing cuts.

See Fig. 110, Wheel and Axle Manual, for proper method of turning journals.

Sharp-nosed tools and coarse horizontal feeds must not be used to finish wheel-seat surfaces.

Wheel seats must not be polished, rolled or filed. A smooth machine cut gives the best results.

(c) New axles and limits of wear dimensions as shown in Fig. 108, Wheel and Axle Manual, must be followed.

(d) Outside micrometer calipers must be used for measuring axle wheel seats.

(e) A taper of 1/32 in. diameter extending a maximum of ½ in.

inward from the dust-guard seat should be turned in the wheel seat to insure true entry into the wheel and to prevent tearing and gouging during mounting.

(f) Centering holes in the ends of axles should have an angle preferably of 60 deg., and an outside diameter of from 1⅛ in. to 1⅜ in., and must have a clearance hole ⅜ in. diameter, 7/16 in. to 9/16 in. deep (see Fig. 109, Wheel and Axle Manual).

Center holes must be wiped clean before placing the axle in the lathe to insure concentricity when turning.

(g) Depressions, continuous streaks or injuries to surface of metal of wheel seat or journals must be removed by a machine cut in a lathe.

Files must not be used on journal surfaces or fillets, but may be used to break the sharp edges of the end collars and dust-guard seat edges.

Journals must never be ground with a coarse abrasive, but may be smoothed with 00 abrasive cloth under light pressure, as prescribed by Wheel and Axle Manual.

(h) Rolling journals to a finish should be done with a hardened-steel roller, having a face 1¼ in. wide and edges turned to radius of ⅛ in. for collar end and radius at other end to suit journal fillet. The roller should be mounted by means of a hardened pin and bushing or by roller or ball bearings in a shank to fit tool-post.

(i) When journals are rolled they must be coated with suitable oil. The following mixtures have proved satisfactory: A mixture of one or two parts of lard oil and one part of paraffin oil, or one part of lard oil and three parts of red machine oil. Before rolling, journal surface must be clean and free from metal chips.

(j) Wheel seats and dust-guard seats must be finished smooth. Journal and journal fillets must be machined smooth before rolling.

(k) Axle wheel seats shall be checked at not less than three points in its length and on two different diameters at each of these points to insure rotundity and absence of taper. The variation for any two of these measurements must not exceed .002 in. Where taper exists within their limit in both axle and wheel bore the tapers must be parallel.

(l) For economical selection of wheels and axles see Fig. 105, Wheel and Axle Manual.

(m) All dismounted axles must be checked in lathe or between centers for rotundity, concentricity and absence of taper of wheel seats and journals before use.

(n) Wheel seats of second-hand axles must be re-turned prior to remounting where there is any evidence of injury to surface.

(o) If journal surface has pronounced coloring due to overheating, or if circumferential checks or cracks are found, or if cracks are found in wheel seats, axle must be scrapped, unless such checks or cracks can be turned out without going below the condemning limits, and the axle Magnafluxed, before being put back into service. (Also see Par. 221 (a), Wheel and Axle Manual, for axle defects and Rules 84, 85 and 86.)

Wheel-Press Practice

(a) Separate presses should be used for mounting and dismounting wheels, where possible, in order to increase production and to save the press used for mounting. If the same press is used for both operations, it should have a capacity of 400 to 600 tons.

Wheel presses must be inspected and checked periodically and maintained so as to give efficient service.

(b) Wheel mounting presses must be provided with a dial pressure gage and a pressure recording gage. These gages must agree with each other and the dial gage must be checked at least every six months by means of dead-weight tester or with an accurate master gage.

(c) The gages must always be used for every mounting operation. The recording gage must make a wheel-fit pressure diagram of the type shown in Fig. 116, Wheel and Axle Manual. The diagram for the mounting of each wheel shall be marked to show the type of wheel, make, identifying number and axle size. The records must be available to A. A. R. inspectors.

During mounting, pressure gage must be watched and, if pressure is outside the limits given in Table, Fig. 115, Wheel and Axle Manual, diagrams showing such misfits must be plainly marked.

(d) In mounting the wheels, both journals must be protected with metal guards during the entire mounting operation to prevent nicking or scratching the journal surface.

(e) Before placing wheels on axle, wheel seats and bore of wheels must be carefully cleaned, then coated with a mixture of basic carbonate white lead and boiled linseed oil, in proportion of 12 lb. of white lead to one gallon of boiled linseed oil, thoroughly mixed. A fresh supply should be mixed every few days.

(f) Wheels must be mounted centrally with respect to the center of the axle, with use of suitable axle centering gage, and mounting gages as shown in Figs. 118 and 119, and paragraphs 247, 248 and 249 of Wheel and Axle Manual.

(g) Wheel mounting and check gages, as well as centering gages, must be checked frequently by shop foreman or test department so that excessive wear will not allow improper mounting of wheels.

(h) New wheels mounted on the same axle must be the same tape size, and bear the same tape-size marking. (See Rule 69.)

Second-hand wheels should be as nearly the same diameter as possible, and must not vary more than ½ tape size, when measured with a standard wheel tape. (See Rule 69.)

(i) It is forbidden to heat the hub of a tight wheel with a torch to assist in dislodging it. Wheels bearing any evidence of such heating, or which have holes burned in the plate by a torch, must be scrapped.

(j) In handling pairs of mounted wheels, wheel sticks must not be used on journal surface.

(k) Journals of mounted axles must be properly coated with rust preventative unless they are going to be placed directly into trucks. Before placing wheels with coated journals in a truck, the coating must be carefully removed with a suitable solvent.

Car-Wheel Lathe Practice

(a) Car-wheel lathes must be maintained so that accurate turning of wheels is assured.

Periodical inspection and check must be made and necessary repairs given when required.

(b) Tools to be used for the complete operation of restoring the tread and flange contour of steel wheels are, a round-nosed roughing tool or round-button tool, which is used to cut the top off the flange and to rough off the tread to within 3/32 in. of the finished tread surface as shown by the scalloped dotted line in Fig. 121, Wheel and Axle Manual, and three finishing tools. These last three tools are forming blades and must not be forced to a degree which will tear the surface of the metal. Turret type or sliding tool-post to hold all the tools should be used so that changing of tools during the operation is not necessary.

(c) Before a pair of wheels is placed in the lathe, each wheel should be taped and gaged at the point where the flange and rim are thinnest with the A. A. R. steel wheel gage at at least three points around the circumference to determine the amount to be turned off to restore the contour.

(d) The A. A. R. steel wheel gage must be used, as referred to in paragraphs 276 to 280, inclusive, Wheel and Axle Manual.

(e) Both wheels of a pair must be turned to the same diameter, and wheel treads and flanges must be concentric with the journal surfaces, and in a plane at right angles to the axis of the axle.

(f) Steel wheels should be re-mated to save service metal when the cost justifies the change of one wheel (see paragraphs 290-291, Wheel and Axle Manual).

Wheel Grinding Practice

(a) Car-wheel grinders must be maintained so that they grind the treads the entire circumference of the wheel truly concentric with the journals.

(b) Cast-iron one-wear wrought- and one-wear cast-steel wheels should not be ground unless they will meet the requirements of the A. A. R. limit gages shown in Fig. 7 and Fig. 8-A (Interchange Rules) for remounting as to flange height, flange thickness, vertical flange and tread worn hollow.

(c) Slid-flat cast-iron wheels should not be ground if they are considerably treadworn, badly brake burned or skid burned, or if they are comby, or if the slid-flat spot is so long that grinding it out might go through the chill.

(d) Water should run continuously on the treads just above the contact with the grinding wheel. During grinding, the tread must not be hot enough to burn the hand.

(e) A bar swung from a rigid frame for accurate calipering should be used frequently to insure that finished wheels will be of the same diameter, and shall be finally checked with a wheel tape before removal from grinder.

(f) Ground wheels must have the date and shop symbol and letter G stamped on them.

A. A. R. Standard Gages

(a) The various gages used in connection with wheel and axle work are listed in Section XX, Wheel and Axle Manual.

(b) These gages must be inspected periodically and checked with master gages by a competent person. When found worn to the limits, they must be repaired or replaced.

Discussion

At the request of the presiding officer, F. H. Hardin, president, Association of Manufacturers of Chilled Car Wheels, referred to the cored-hub wheel, commenting on the possibility of saving some metal when metal is scarce. He said that this type of wheel saves about 25 lb. of useless metal which retards cooling; the new construction gives a better mechanical job; the wheels can be shaken out of the mold more quickly, and stresses are better distributed. He said that the association appreciates an opportunity of working with the committee in effecting improvements in chilled-iron wheels. Mr. Hardin referred to the shortage of scrap wheels for melting stock and said that the only other substitute, pig-iron, is not entirely desirable, besides being somewhat difficult to secure at the present time. In addition to ordinary wheel replacement, the great amount of new car equipment in prospect is creating a heavy demand for chilled iron wheels and it is important, from the point of view of the railroads and wheel manufacturers alike, to return as many scrap chilled-iron wheels as possible for remelting and making into new wheels.

Supplementing his previous comments, C. T. Ripley, chief engineer, Technical Board, Wrought Steel Wheel Industry, referred to shop practice. He explained that the use of modern gages and close tolerances is very necessary but raised the question how railway wheel-shop forces are to do this kind of work with the old and worn-out machine equipment still so generally found in many shops. Mr. Ripley paid tribute to the class of men who now work in railway wheel shops but are handicapped by antiquated machinery often in poor mechanical condition. He appreciated the difficulty of getting new replacement machinery for railway wheel shops at the present time, but indicated that much can be done to place present equipment in better operating condition. He suggested that wheel shop supervisors themselves be required to produce the same accuracy of fits and close tolerances which they are asking their machine operators to obtain from these worn machines.

The report was accepted and submitted to letter ballot.

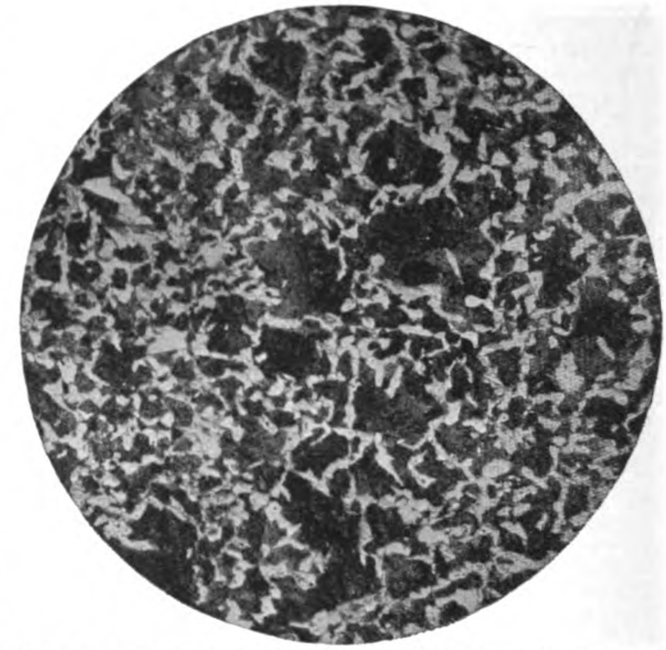
Specifications for Materials

The committee submits the following revisions to certain existing material specifications for consideration: Specifications M-101-39, axles, carbon steel, for cars and locomotive tenders (Exhibit A) and Specifications M-102-40, forgings, carbon steel, annealed and unannealed (new Par. 13 to be added and subsequent paragraphs being renumbered). New Par. 13 is as follows:

13.—Microscopic Tests.—(a) One microscopic test shall be made from each annealing charge. If more than one melt is represented in a charge, one microscopic test shall be made from each melt. The sections for microscopic test shall be cut from the large undistorted portion of the tension test specimen in such a way as will give one face normal and one face parallel to the axis of the specimen.

(b) Both faces shall be polished practically free from scratches. The transverse face shall be etched with four per cent solution of nitric acid in alcohol. The longitudinal face to be left unetched. The specimen shall be examined under a magnification of 100 diameters.

(c) The whole of the transverse section shall show uniform, well broken up, fine grained structure, and shall conform to the requirements illustrated in photomicrographs (Exhibit B). Only one irregular mesh as large as ½ in. in diameter shall be permitted in a field 3 in. in diameter, as shown on the screen or photomicrograph.



Maximum grain structure acceptable in grade B annealed carbon steel forgings

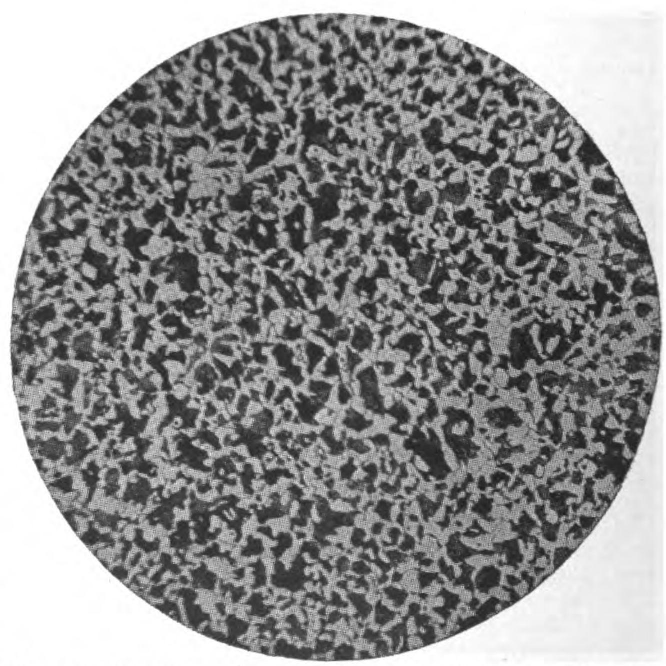
(d) For information only, the longitudinal unetched face will be examined for solid non-metallic impurities and should show such impurities well scattered over the field.

Specifications M-105-34, blooms, billets and slabs for forgings. Recommended changes to be made are as follows: New Par. 11 (present Par. 11 and subsequent paragraphs renumbered) to be added to this specification, to read as follows:

"*11.—Cutting.*—Cutting or parting of material shall not be done by flame cutting except by methods approved by the purchaser involving preheating and temperature control when necessary to avoid any damage to flame-cut surface.

Specifications M-302-40, refined wrought iron bars. Changes to be made as follows: Page 3, Sec. 9 (b):

"*(b) Bend Test Specimens.*—Round, square and hexagonal bars not over 1½ in. in diameter or thickness, and flat bars not



Fine grained uniform structure desired in grade B annealed carbon steel forgings

over 1½ in. in width or 1 in. in thickness shall be bent in full section as rolled. For larger round, square, and hexagonal bars, the bend specimen may be machined to 1½ in. diameter. For flat bars wider than 1½ in. but less than 1 in. thick, the bend specimen may be machined to 1½ in. in width. For flat bars 1 in. or thicker, the bend specimen may be machined to 1 in. square. The edges of the machined specimens shall be rounded to a radius of 1/16 in."

Specifications M-603-38, Hose—Air, Gas and Oxygen, Wrapped and Braided. In compliance with request that a ½-in. size hose for gas and oxygen be included in these specifications, the specification has been revised accordingly, and recommended revision is given in Exhibit C.

Specifications M-607-38, rubber goods, general instructions on standard methods of tests for. Recommended revision of this specification is given in Exhibit D. In addition to some editorial changes, the revision consists of the following: (a) Methods of measuring lengths, diameters and thickness of hose and component parts thereof. (b) Specified A. S. T. M. Die B, ¼ by 2 in., replacing the die now used, of ½ in. (c) Specifying the use of micrometer exerting a force of 3 oz. rather than 9 oz. [Exhibits A, B, C, D are not included in the present abstract of the committee's report.—Editor.]

All of the material specifications have been studied in detail during the past year, and while some changes have been agreed upon, in view of manufacturing conditions and the market situation, it is felt inadvisable to recommend changes to be made this year, other than included in the above.

The various members of the Committee on Specifications for Materials have cooperated with other committees in connection with various investigations and specifications drafted by the other committees, handled by them and incorporated in the annual reports of such other committees.

The report was signed by T. D. Sedwick (chairman), engineer of tests, C. R. I. & P.; F. Zeleny, engineer of tests, C. B. & Q.; H. G. Burnham, engineer of tests, N. P.; H. P. Hass, engineer of tests, N. Y. N. H. & H.; J. R. Jackson, engineer of tests, M. P.; H. G. Miller, engineer of tests, C. M. St. P. & P.; L. B. Jones, engineer of tests, Penna.; C. B. Bryant, engineer of tests, Sou.; W. R. Hedeman, engineer of tests, B. & O.; W. F. Collins, engineer of tests, N. Y. C.; and W. Bohnstengel, engineer of tests, A. T. & S. F.

The report was accepted and the recommendations submitted to letter ballot.

Report on Car Construction

Designs of Standard Cars

Lightweight Steel-Sheathed Box-Car Designs

Last year a program was outlined for the development of lightweight box-car designs in coöperation with the Freight Car Design Committee of the American Railway Car Institute. Tentative designs for four types of construction referred to were submitted for study and analysis. The committee did not submit recommended light weight box car designs at this time. It is proposed to progress this matter with the A. R. C. I. as conditions permit.

Lightweight Hopper Cars

The situation with respect to the development of designs for lightweight hopper cars of 50 tons and 70 tons nominal capacity, in cooperation with the A. R. C. I., is the same as for the lightweight box-car designs. No change has been made in the development program as outlined under Welded Hopper Cars in the annual report for 1940.

50 ft. 6 in. Steel-Sheathed Box and Automobile Box Cars

Arrangements were made during the last regular meeting of the committee, held in March of this year, for the preparation, in cooperation with the A. R. C. I., of designs for steel-sheathed box and automobile box cars of carbon-steel riveted construction having the following clear inside dimensions:

Length between end linings	50 ft. 6 in.
Width between side linings	9 ft. 2 in.
Height at eaves	10 ft. 6 in.

Provision will be made in the base design of the box car for single side doors of clear opening width to meet traffic requirements as will be developed through the Traffic and Operating-Transportation Divisions. In the base design of the automobile box car double side doors having staggered openings 15 feet clear width will be incorporated.

For both the box- and automobile box-car designs, alternate applications of double end doors in one end of the car will be developed.

Overall dimensions for both types of cars will be made to come within the maximum operating clearance outline, Exhibit N dated March 28, 1940, as tentatively agreed upon and now the subject of a separate investigation being made by the Engineering Division. (This was shown as Fig. 1 in the report.)

Cars Ordered From May 1, 1940 to May 1, 1941

Included in the report was a detailed tabulation of 55,505 house type and hopper cars ordered during the above period. An analysis of the figures indicates that the roads have followed A. A. R. design recommendations to the extent shown in the following summary:

Design	No. of cars	Per cent of total
A. A. R. throughout or conforming thereto including lightweight alloy steel to A. A. R. base dimensions, floating center sills, and inside dimensions to meet specific conditions	49,870	89.85
A. A. R. except 26¾ in. center-plate height	2,000	3.60
Not A. A. R. except center sills and 25¾ in. truck height	550	.99
Not A. A. R. design except 25¾ in. truck height	3,000	5.41
Not A. A. R. design	85	.15
Total	55,505	100.00

Another tabulation showed that of the total of 85,794 cars listed 73,825 or 86.05 per cent have standard 25¾-in. center-plate height, 11,110 or 12.95 per cent have 26¾-in. center-plate height, 360 or .42 per cent have 26-in. center-plate height, 300 or .34 per cent have 26⅛-in. center-plate height, 190 or .22 per cent have 27⅝-in. center-plate height, 5 or .01 per cent have 23¼-in. center-plate height, 2 or .005 per cent have 24¾-in. center-plate height, and 2 or .005 per cent have 27-in. center-plate height.

Standard Steel-Sheathed Box Cars

Since the introduction of the A. A. R. standard box car of larger dimensions as covered by the drawings included in the 1937 report of the Committee on Car Construction, there has been little demand for the drawings covering the 8 ft. 9⅛ in. wide, 9 ft. 4 in. high box car.

In accordance with action at March meeting of Committee on Car Construction, the following drawings now in the Supplement to the Manual will be removed: 500-B; 501-B; 502-B; 503-B; 504-B; 505-B; 506-A; 507-A; 512-B; 513-A; 514-A; 515-A; 516-C; 517-B, and 524-A. The original tracings of these plates will be available in the office of the secretary in case any railroad requires copies of same.

Drawings in the 1500 group covering the larger car are being revised to show reinforced floor structure, improved corner post construction and roof application as referred to in the 1940 report of the car construction committee and subsequently approved by letter ballot.

Due to insufficient time it has not been possible to revise the general drawings now in the Supplement to the Manual for inclusion and issuance as a part of the annual report for this year. It is anticipated, however, that these revisions will be completed by the date of the annual meeting. In the meantime, any road which contemplates building cars of this construction can obtain information from the secretary's office as to the revisions which are being made.

Standard Hopper Cars

As a result of additional experience in the construction and operation of A. A. R. standard 50- and 70-ton self-clearing hopper cars, cértain further changes have been made in details of design such as sill steps, body center plate, bolster center fillers, and cubic capacity. The drawings have been revised to cover the various features referred to.

Cubic Capacity

Calculations have been made for the 50- and 70- ton A. A. R. hopper cars, and the following information has been shown on general arrangement drawings 600-D and 601-D:

	50-ton hopper	70-ton hopper
Cubic capacity (level full)...............	2,145 cu. ft.	2,773 cu. ft.

Body Center Plate (70-ton Hopper)

To avoid interference with truck center plate rim, it is necessary to countersink the heads of the four inside rivets ($4\frac{3}{16}$ in. each side of center line of car) on under side of body center plate and the following drawings have been revised to show:

Bolster Center Fillers

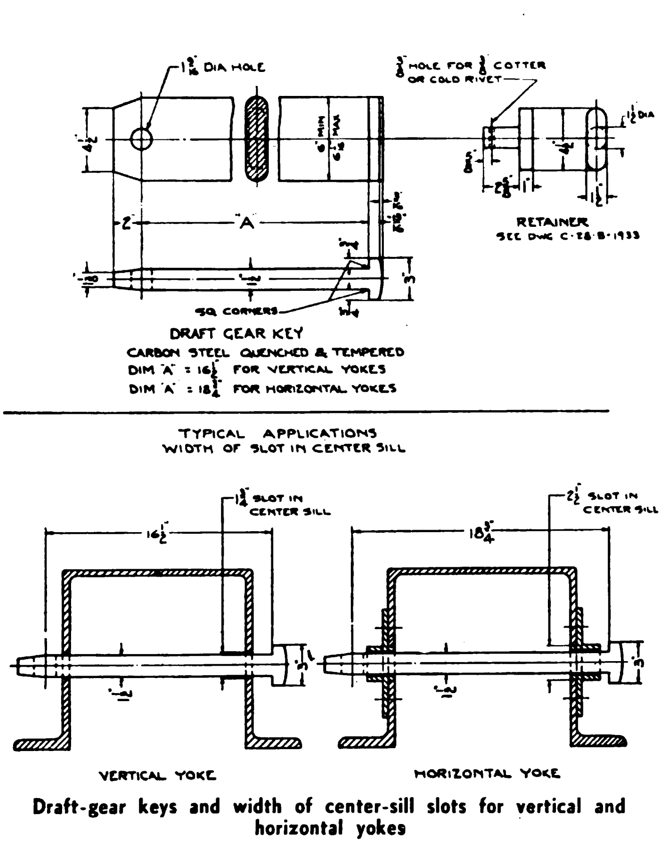
To show correct rivet spacing for both 50- and 70-ton hopper cars, drawing 611-D and 612-C showing bolster center fillers have had table added showing distance from center line of car to inside rivet holes.

Draft-Gear Key and Retainer Key Slot in Center Sills

Plate 214 in the Supplement to the Manual shows a draft-gear key of one length. Inasmuch as it is the general practice to use keys of different lengths for vertical yoke and horizontal yoke, and the width of the slot in the center sill varies, depending upon which type of attachment is used, a new drawing has been prepared to show a standard draft key and retainer with dimension from underside of head to center of retainer hole and width of slot required in center sills as follows:

	Vertical yoke	Horizontal yoke
Under head to center of retainer hole......	16½ in.	18¾ in.
Width of slot in center sills	1¾ in.	2½ in.

The depth of the head on the draft key has been increased from 2½ in. to 3 in.



Draft-gear keys and width of center-sill slots for vertical and horizontal yokes

It is recommended that new drawing C-28-D-1941 be submitted to letter ballot, and if approved, that it will be inserted in the Manual, superseding plate 214 now in Supplement to Manual, which will be removed.

Design Dimensions for Separable Pedestal Type Journal Boxes "E", "F" and "G"

In view of the increasing use of larger size axles on heavy freight equipment, as well as locomotive tenders, drawings have been prepared to show design dimensions for pedestal-type journal boxes for use with 6 by 11-in., 6½ by 12-in. and 7 by 14-in. journal axles. These designs are based on boxes of this type furnished by various manufacturers and include recess in top of box for leaf spring band which represents the construction most commonly in use.

It is recommended that these drawings be submitted to letter ballot, and, if approved, arrangements will be made to include them in the next revision of the A. A. R. Manual of Standards and Recommended Practice.

Front and Back Draft Stop

Page 39, Section "C," of the A. A. R. Manual of Standard and Recommended Practice illustrates as standard adopted in 1907, designs of Front and Back Draft Stop.

The introduction and use of the more modern designs of strikers with integral front draft stops and bolster center fillers with integral back draft stops on the A. A. R. standard cars as well as other modern cars, has made the separable draft stops obsolete.

It is recommended that the removal of drawing C-39 from the Manual be submitted to letter ballot.

Record of Revisions in Drawings and Specifications in Supplement to Manual

In connection with action at the Car Construction Committee meeting of March, 1940:

Sheets showing record of all revisions to date for the 500, 600 and 1500 Series Drawings as well as the box-, hopper-, and refrigerator-car specifications have been prepared. These sheets were included as a part of the report.

Originals will be kept currently up-to-date and will be retained in the office of the secretary, where they will be available as a matter of information and record.

Bolster Center Fillers and Strikers

The present designs of cast steel strikers and bolster center fillers have been widely produced and used since 1932.

The many thousands of cars which have been built, embodying these present designs, amply prove how adequately and efficiently these designs of 1932 have served their purpose.

Since 1932 certain refinements and developments have made possible reduction in weights and production costs. During the same period the art of fabrication by welding has been considerably developed, and is now more generally used in car construction.

The Manufacturers' Committee on cast-steel strikers and bolster center fillers submitted to the Car Construction Commitee a report and detail designs covering the following types of strikers and bolster center fillers in Grade B steel: (a) Reduced-weight riveted designs; (b) Reduced-weight designs for manually welding to sills; (c) Reduced-weight designs of bolster center fillers for automatically welding to the sills.

The reduced weight designs of strikers and bolster center fillers are based on static and dynamic tests on test specimens consisting of short lengths of the A. A. R. standard Z-sills having the castings attached by rivets or welds in accordance with the designs tested. These tests indicated that an appreciable saving in weight could be made without sacrificing strength.

The riveted designs have been reviewed by the committee and it is recommended that they be added to the Supplement to the Manual with new numbers. Reference to these new numbers will be made on the general arrangement drawings for the box and hopper cars.

The striker details are the same on both hopper and box cars.

The proposed reduced-weight designs for welding to the sills were approved by the committee, but the details are not recommended to be shown in the Manual; however, details of these

will be available and may be obtained through the office of the Secretary of the A. A. R.

In view of the development of the art of die-pressing bolster center fillers to suitable tolerances instead of machining, it is recommended that die pressed center fillers be made a permissible alternate.

Trucks for High-Speed Freight Service

Since last fall the American Steel Foundries have been conducting tests with existing freight-car trucks to see what can be accomplished to improve these trucks in freight service, but to date nothing has been released that would be of interest.

Standardization of Axles Equipped with Roller Bearings

The A. A. R. Committee on Axle Research has now developed axles for 5½ in. by 10 in. and 6 in. by 11 in. journals, based on the new design of passenger-car axles, that will be suitable for application of Timken, Hyatt, S-K-F, and Fafnir roller bearings. The axle committee is continuing this subject to include axles having 4¼ in. by 8 in., 5 in. by 9 in., and 6½ in. by 12 in. journals. As soon as these designs have been completed it is the intention to prepare a report and issue drawings showing all of the axles that will be suitable for interchangeability of roller bearings manufactured by the four companies referred to.

When these axle designs are completed they will also be satisfactory for tender journals.

Passenger-Car Axles

Recommendation was contained in the 1940 report of the Committee on Car Construction for the adoption of new designs of axles A, B, C, D, E and F for new passenger cars. The details of tests and study leading to this recommendation was included in the Fourth Progress Report of Passenger Car Axle Tests, dated April, 1940, and sent to the members about June 1, 1940. The letter ballot vote to adopt these designs for passenger car axles was nearly unanimous and the designs have been incorporated in the Manual of Standard and Recommended Practice.

It is expected that tests to determine the proper material specifications for passenger car axles for heavy duty service will be completed in a short time and soon thereafter report and recommendations will be submitted to the members.

Tubular Car Axle

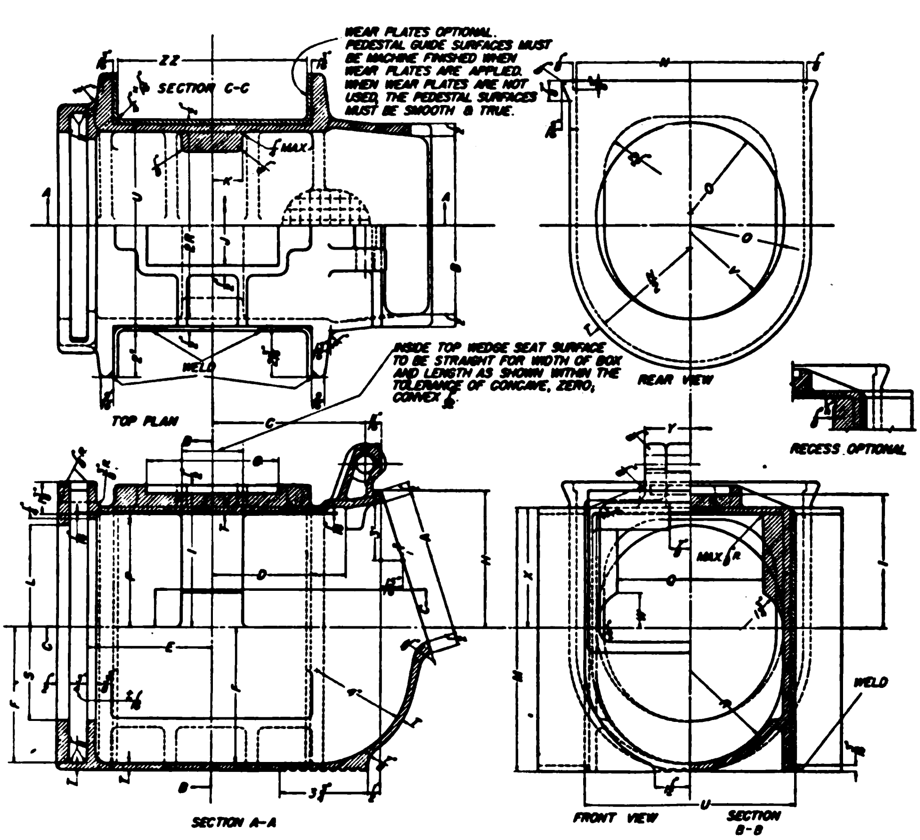
Under date of October 20, 1939, H. C. Urschel submitted application for approval of a new type of tubular railroad-car axle. This application was considered by the Committee on Axle Research at a meeting held October 16 and 17, 1939, and Mr. Urschel was advised it would be necessary to conduct fatigue tests with full-size specimens of his axles on the A. A. R. fatigue testing machines located at the plant of the Timken Roller Bearing Company, Canton, Ohio, and the results of these tests submitted to the Axle Committee before any approval for such type of axle could be considered. This advice was transmitted to Mr. Urschel under date of December 11, 1939.

The fatigue tests were conducted during the months from January to August, inclusive, 1940. Charles P. Palmer submitted a summary of the tests and requested that this matter be placed before the proper committee of the Association for consideration of this type of axle for use on equipment in interchange. The application was referred to P. W. Kiefer, chairman, Committee on Car Construction, who directed under date of September 16, 1940, that this request should first be submitted to the Axle Committee for review and recommendation as to what it thought should be done or would be necessary. Accordingly, the request was submitted to the Axle Committee at a meeting held in Canton October 16 and 17, 1940, at which time the following action was taken:

After a thorough discussion of the tubular axles of the Pittsburgh Steel Company the committee instructed the secretary to advise the Committee on Car Construction that the tests of this axle so far conducted have only demonstrated the relative comparison of wheel-seat section of the class of heat-treated material used in this design of axle and it was the opinion of the committee that before approval can be given to the general, or even limited application of this type of axle, data should be submitted of possible service performance of this type of journal when either overheated as a whole or locally at various temperatures equal to that of molten brass. It was the further feeling of the committee that this information relative to the journal should be esablished on both journal of nominal and minimum dimensions.

This action was referred to the Committee on Car Construction and was considered by that committee at a meeting held in Chicago on October 24 and 25, 1940. It was the consensus of opinion of the Committee on Car Construction that this matter

Journal box for large size axles



should be left in the hands of Mr. Cantley and the Axle Committee for thorough investigation before it could be considered for interchange service. Among other things this would include the questions referred to in the action taken by the Committee on Axle Reaserch at its meeting of October 16 and 17, 1940, quoted above.

It was also the consensus of opinion of the Committee on Car Construction that efforts such as this should be encouraged as being along the lines of advancing the state of the art both from the standpoint of material and design, and in the interest of better performance, and that Mr. Cantley and his committee should cooperate fully in the development of such further tests as should be made to demonstrate the suitability of this axle for general interchange service.

The Urschel Engineering Company conducted the tests required by the Axle Committee and furnished their findings in two reports. These two reports were considered at a meeting of the Axle Committee held in Chicago on December 19, 1940.

After reviewing all the data on laboratory tests on their tubular axle and also information obtained from tests conducted at Canton, the committee was of the opinion that this type of tubular axle, as made by the process set forth by the Pittsburgh Steel Company, had merit. However, the committee felt that additional laboratory tests should be made on the journal portion of the axles to determine the relative sensitivity to injury due to local overheating of the tubular axle as compared with the solid axle.

The committee also specified that the workmanship of the axle should be entirely smooth, both exterior and interior, and entirely devoid of any tool marks, die marks, or other imperfections that might cause failure of the axle; also that it is very important that the axle be concentric and that care must be exercised to insure such concentricity throughout the axle with uniform wall thickness at the journal, wheel seat, and center portion of the axle.

A meeting of the Axle Committee was held on January 23, 1941, at which time further consideration was given to the additional tests of the tubular axle. After considerable discussion it was decided that additional tests should be made on the journal portion of the axles. To assist the Pittsburgh Steel Company it was agreed that the Chairman, Mr. Sedwick, and Mr. Johnsen should help them to set up a program to determine the relative sensitivity of injury due to local overheating of the tubular axle compared with solid axles. On January 7, 1941, the Chairman, Mr. Sedwick and Mr. Johnsen met with Mr. Urschel and explained to him what they considered should be the method of making these additional tests. They further suggested that he contact the Engineer of Tests of the Pennsylvania Railroad at Altoona to see if their drop test machine could be used for suggested tests. Mr. Urschel visited Altoona and found that the Pennsylvania Railroad had a machine that would be satisfactory for this purpose. In discussing this subject again at the meeting with the A. A. R. representatives at Canton it was agreed by the committee that in making the drop tests the local heating effect should be established according to the method demonstrated by Mr. Urschel wherein the distance from the surface of the axle to the outlet of a No. 12 tip is to be 3/8 in., and heat to be applied 2 in. out from the dust-guard seat of the journal and the time of heating two minutes. The temperature of the surface to be read as a matter of record during the time the torch is applied to the journal with 50 lb. air pressure and 5 lb. gas pressure.

For comparative purposes two axles to Specifications M-101, Design 6, were furnished for test by the A. A. R., the journals to be machined to 5¼ in. diameter and the wheel seats to be machined to 7 9/16 in. diameter. After this machining had been done the axles were shipped to H. C. Urschel, Pittsburgh Steel Company, Allenport, Pennsylvania.

The drop tests were started on February 11 and completed on February 13, 1941. Prior to witnessing the drop tests at Altoona, the committee visited the plants of the Pittsburgh Steel Company at Monessen and Allenport, Pa., where they inspected the methods used in forging the tubular axles. After the drop tests were completed a report was prepared and the results of the tests were considered at a meeting of the Axle Committee held in Chicago on March 6. In addition to discussing the report on drop tests, the two former reports were also reviewed and again thoroughly considered. The Axle Committee finds that the Urschel Engineering Company, which is handling this matter for the Pittsburgh Steel Company, has complied with all requests the Axle Committee made for tests. The cost of all these tests has been assumed by the Urschel Engineering Company and the Pittsburgh Steel Company and consequently there has been no expense to the Association in conducting these tests.

Conclusions

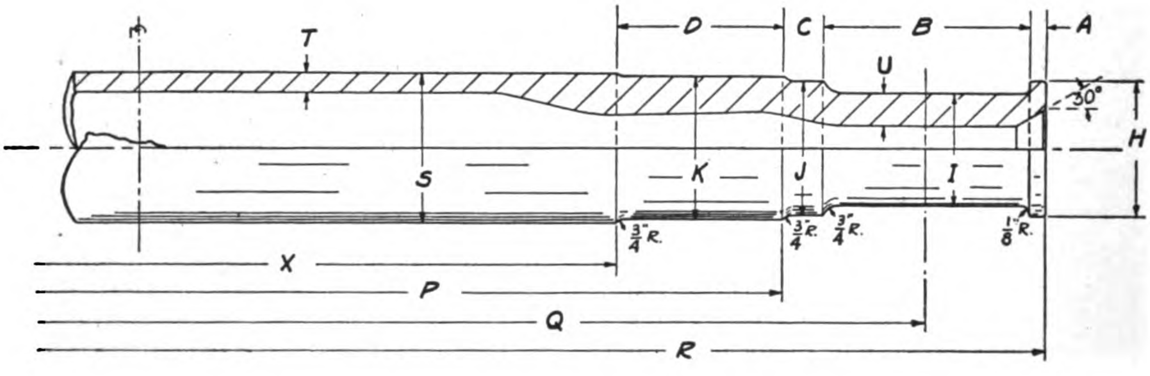
(1) Possible service performance of this type of journal when either overheated as a whole, or locally, at various temperatures equal to that of molten brass. Tests indicated that the heating of the journal of the tubular axle did not affect the functional strength of the axle in any way because the journal portion is much heavier in proportion to the load it must carry than the inside of the wheel seat where the maximum stresses occur.

(2) Deflection of journals—A. A. R. Design No. 6 axle and tubular type axle. In the drop tests the journals of both types of axle were subjected to the same type drop tests; that is, starting at one foot with a 2,000-lb. tup, and increasing the height by increments of 6. in. up to 6 ft.

Permanent set with the center of the axles clamped rigid. The total set of the solid axle was 1.4 in., 1.34 in., and 1.39 in.; of the tubular axle, 0.68 in.

Tests made with axle center free to flex. Solid axle, 0.74 in.; tubular axle, 0.48 in.

Permanent set at the center of the solid axle was 0.34 in. and of the tubular axle 0.03 in.



Class of axle	Size of journal, in.	Dimensions														
		A in.	B in.	C in.	D in.	H in.	I in.	J in.	K in.	P ft.–in.	Q ft.–in.	R ft.–in.	S in.	T in.	U in.	X ft.–in.
B	4¼ x 8	5/8	8	2	8 1/16	5¼	4¼	5¼	5¾	5–3	6–3	7–0¼	6	¾	1 3/16	3–10 7/8
C	5 x 9	¾	9	2	8 1/16	6 1/8	5	6 1/8	6½	5–3	6–4	7–2½	6¾	7/8	1½	3–10 7/8
D	5½ x 10	¾	10	2	8 1/16	6 5/8	5½	6 5/8	7	5–3	6–5	7–4½	7¼	1	1½	3–10 7/8
E	6 x 11	7/8	11	2¼	8 5/8	7¼	6	7¼	7 5/8	5–2½	6–6	7–6¾	7 7/8	1	1	3– 9¼
F	6½ x 12	7/8	12	2¼	8 5/8	7¾	6½	7¾	8 1/8	5–2½	6–7	7–8¾	8 3/8	1 1/16	1 5/8	3– 9¼

Dimensions of Urschel-Pittsburgh tubular car axle

One end of two of the tubular axles broke off, one at a drop of 5 ft. 6 in., and the other at 6 ft., but both of these axles were clamped rigid in the center and it was felt that this was a contributing cause as an inspection of the metal after failure did not indicate any poor structure.

(3) All of the tubular axles tested were designed to maintain the old wheel fit diameter of 7 in. which is the standard nominal diameter for 5½ by 10-in. journals, whereas the solid axles recently redesigned by the Axle Committee require 7 9/16-in. diameter wheel fit. The design of the tubular axle is such that it does not require the same diameter of wheel fit that is required by the redesigned solid axle.

(4) The tubular axles we tested might be considered as hand-made axles and did not include all the refinements that could have been obtained if they had been made with proper forging equipment. With the proper forging equipment for manufacturing this type of axle there will be an entirely smooth finish both on the exterior and interior of the axle and uniform sections throughout. The smoothness of the finish will be comparable to the tubing that is now being made by the same forging process the axles are to be made of and upon inspection we found this to be a smoother finish than could be obtained by turning.

(5) While all tests of the tubular axle were conducted with axles having journals of 5½ in. by 10 in. so as to be comparable with the A. A. R. tests of solid axles, a drawing dated March 20, 1941, showing the design of Urschel-Pittsburgh tubular Railway Axles for journals 4¼ by 8 in. up to and including 6½ by 12 in., is included.

Advantages of the Tubular Axle as Compared with the New Design Solid Axle

(1) The tests conducted with the Urschel-Pittsburgh tubular railway axle at Canton indicate that the wheel seat and body construction has more than a 25 per cent increase in fatigue strength compared with the new A. A. R. Design No. 6 axle for 5½ in. by 10 in. journal; and the new A. A. R. Design No. 6 axle has from 60 to 80 per cent greater allowable design fatigue strength than the present 5½ in. by 10 in. journal A. A. R. axle with the "black collar."

(2) Increased loading capacity with increased factor of safety.

(3) Interchangeability with the A. A. R. standard solid axles.

(4) Material decrease in weight. As an example, the 5½ in. by 10 in. journal tubular axle weighs approximately 275 lb. less per axle than the solid axle with the same size journal. The proportionate reduction for tubular axles having journals larger than 5½ in. by 10 in. will be greater.

(5) The committee has no information on the relative costs of the tubular axle as compared with the solid axle, but in making such a comparison it should be with the new design A. A. R. passenger car axles which require that the body of the axle be smooth-machined between wheel seats.

(6) The tubular axles are heat treated by a special heat treating process and it was found from actual tests that by this method of heat treating the wear of the journal between collars increases less rapidly than with the untreated solid axles.

Recommendations

In view of the above investigation by the A. A. R. Committee on Axle Research, the committee recommends that the Urschel-Pittsburgh tubular railway axle be approved for general interchange service. In giving this approval, however, it is to be understood that it is for this make of axle only and should any other manufacturers of axles ask for approval of hollow or tubular axles, such axles will be required to go through the same series of tests that were required of the Urschel-Pittsburgh Tubular Railway Axle.

The above report with conclusions and recommendations was considered by the Committee on Car Construction at a meeting held in Chicago on March 13 and 14, 1941, and after discussing the entire report of the Axle Committee in detail the Committee on Car Construction recommended that the Urschel-Pittsburgh tubular railway axle be submitted to letter ballot to be adopted as an alternate interchange standard for all purposes.

Report on Side Frames and Bolsters

During the past year numerous new designs of side frames and bolsters were submitted for approval. Seventeen new designs of side frames and eight new bolster designs have been approved, while eleven side frame designs and eight bolsters have applications pending.

The report also included a complete tabulation of side frames and bolsters approved to date and a similar tabulation of designs on which applications are pending.

Report of Sub-Committee on Definitions and Designating Letters

Since the last annual report the sub-committee has passed upon the following which have been approved by the members through letter ballot:

Substitute the following for the present definition for *LF* cars:

LF—A flat car equipped with one or more demountable containers for the transportation of liquids or other commodities, not under refrigeration.

Reason—The old definition is in conflict with the new definition for *RC* cars.

Adopt a new designation and definition for *RC* cars as follows:

RC—A car equipped with one or more demountable insulated containers. The containers may be equipped with facilities for refrigeration.

Reason—To provide for a new type of car.

Adopt a new designation and definition for *LFA* cars as follows:

LFA—A flat car equipped with a container or containers for transporting commodities immersed in liquids or gases.

Reason—To provide for a new type of car.

The committee has also passed favorably upon the following and recommended that it be submitted to letter ballot:

Substitute the following for the present definition for *FG* cars:

FG—Flat or gun truck car for special transportation of heavy ordnance or other heavy commodities.

The report was signed by P. W. Kiefer (chairman), chief engineer motive power and rolling stock, N. Y. C.; T. P. Irving (vice-chairman), engineer car construction, C. & O.; W. A. Newman, chief mechanical engineer, Can. Pac.; J. McMullen, superintendent car department, Erie; R. D. Bryan, engineer car construction, A. T. & S. F.; G. S. Goodwin, mechanical engineer, C. R. I. & P.; H. L. Holland, assistant engineer, B. & O.; L. R. Schuster, engineer car construction, Sou. Pac.; J. T. Soderberg, general foreman, Pennsylvania; T. M. Cannon, engineer car construction C. M. St. P. & P.; and F. J. Jumper, general mechanical engineer, Union Pacific.

Discussion

K. F. Nystrom, mechanical assistant to chief operating officer, Chicago, Milwaukee, St. Paul & Pacific, suggested that a special committee be appointed during the present emergency in order that immediate action might be obtained on developments in car construction. He also recommended to the Association the adoption of a standard design for roller-bearing axles and boxes as well as car wheels. He felt that one standard axle for roller bearings, somewhere between the 5½-in. by 10-in. and 6-in. by 11-in. sizes would meet the requirements of the railroads.

Another member thought that the tubular axle should be given special consideration at this time not only because it would save steel but it would also reduce the dead weight hauled in trains. In speaking of the tubular axle, one member wished to know what part of the increased strength obtained in this axle was due to design and how much was the result of heat treatment. In reply, W. I. Cantley, mechanical engineer, Association of American Railroads, expressed the opinion that all factors had contributed to the greater strength of the tubular axle.

H. H. Lanning, mechanical engineer, Atchison, Topeka & Santa Fe, stated that his road had 400 axles of the 7-in. by 13-in. size and no provision had been made for this size of axle in the report. Mr. Cantley replied that designs for both the 7-in. by 13-in. and the 7½-in. by 14-in. separable pedestal-type journal boxes had been prepared but had not yet been submitted. A member of the committee made the statement that the 7-in. by 13-in. journal box will be included in the recommendation.

The report was accepted and the recommendations submitted to letter ballot.

EDITORIALS

Patience and Long-Suffering—A Remarkable Example

On page 297 in this issue is a report of a proposal by President D. B. Robertson of the Brotherhood of Locomotive Firemen and Enginemen in the July issue of the union's magazine entitled "Railroad Wages—One Million Americans Can't Be Wrong." In justification of the recent demands of the transportation non-operating unions for a basic wage increase of 30 per cent, Mr. Robertson declares that railway wages are not high and that they have not kept pace with those in similar industries. "The public," he says, "in many instances is not fully aware of the patience of railroad labor, since transportation workers have not as yet been given an opportunity to participate in the improved condition of their own industry as in the case of other workers. Moreover, while the railroads are one of the country's largest industries, their employees have never known the job and wage security that the public mistakenly attributes to them."

In the table are presented the average weekly earnings, the average hours worked per week, and the average hourly earnings of employees in a number of industrial and non-industrial occupations, published by the Bureau of Labor Statistics of the United States Department of Labor. Most of these figures are averages for entire industries. In a few cases where average earnings of small groups within the industry are considerably higher than the general average for the industry, these higher paid groups have also been included.

The table also includes the railway brotherhoods and the three largest groups of railway shop employees; that is, the boiler makers, car men C and D, and machinists. The data for the railway employees were obtained from the Wage Statistics of Class I Steam Railways in the United States by converting the average total earnings and the average straight time actually worked from a monthly to a weekly basis and calculating the average hourly earnings by dividing the total compensation by the straight time actually worked.

The latest available data for industries other than transportation is for the month of February, 1941, and figures for this month have been used throughout. In order that there may be some indication of the trend in earnings, hours, and wage rates, the table also includes the data for February, 1940.

Among the highest paid groups in industry are those employed in the building of machinery, among which those employed in the manufacture of cash registers, adding machines, and calculating machines have the highest weekly earnings. Those engaged in the building of transportation equipment average particularly high, with the automobile workers taking the lead in this group. These men average over $40 a week. Another outstanding industry from the viewpoint of average weekly earnings is newspaper and periodical printing. The employees in this line of business average over $38 a week and more than $1 an hour for the time worked.

The poorest paid group among the operating brotherhoods are the yard firemen and helpers. All of these men who received pay during the month of February, 1941, averaged $36.70 a week. The next lowest paid among the brotherhoods are the freight brakemen and

A Comparison of Average Weekly Earnings, Hours Worked, and Hourly Earnings in Various Businesses

Type of business	Avg. weekly earnings, Feb., 1940	Avg. weekly earnings, Feb., 1941	Avg. hours worked per week, Feb., 1940	Avg. hours worked per week, Feb., 1941	Avg. hourly earnings, cents, Feb., 1940	Avg. hourly earnings, cents, Feb., 1941
Iron and steel products	$27.95	$32.25	36.5	40.7	76.4	79.1
Blast furnace and rolling mills	29.69	34.57	35.4	39.9	83.8	86.8
Machinery, excl. transportation equipment	29.67	34.28	40.1	44.2	73.7	77.1
Cash registers, etc.	32.17	36.99	39.1	43.4	82.5	86.2
Transportation equipment	33.36	38.44	37.7	42.1	89.4	91.6
Cars, electric and steam	28.83	30.66	39.1	39.3	73.8	77.4
Locomotives	28.93	34.95	37.4	43.1	77.3	81.1
Automobiles	34.74	40.05	37.2	41.1	93.5	97.5
Non-ferrous metals and products	26.65	31.12	38.4	42.1	69.6	73.9
Textile fabrics	16.98	18.60	35.7	38.3	48.4	49.2
Hats, fur felt	25.13	29.52	35.4	38.6	73.2	77.1
Wearing apparel	18.86	20.39	34.0	35.7	54.4	55.5
Leather manufactures	19.61	21.89	36.7	39.1	53.7	56.4
Food	25.00	25.25	39.5	39.5	63.9	65.1
Beverages	32.77	33.72	37.6	38.0	87.7	88.9
Paper and printing	28.37	30.01	37.8	39.1	78.3	80.3
Newspaper, periodicals, printing	37.59	38.42	35.9	35.7	101.8	105.1
Chemical, petroleum, coal products	29.31	30.22	38.4	38.8	75.5	77.0
Petroleum refining	34.78	34.44	35.9	35.7	97.5	97.0
Rubber products	27.40	31.14	35.3	39.5	77.7	78.5
Rubber tires and inner tubes	32.15	36.73	33.6	38.2	96.3	96.5
Lumber and allied products	16.69	21.41	37.9	39.7	51.3	53.6
Stone, clay, and glass products	23.71	25.62	35.4	37.2	66.2	68.3
Bituminous coal	26.02	26.77	29.8	30.4	87.7	88.7
Crude petroleum production	34.22	33.56	38.3	37.3	87.4	89.7
Electric light and power	34.94	35.72	39.8	39.6	87.4	90.6
Trade, wholesale	29.53	30.69	40.9	40.6	72.2	75.9
Trade, retail	21.44	21.59	42.9	42.7	54.5	54.6
Railway passenger conductors	60.40	62.20	34.5	35.0	175.0	177.5
Railway freight conductors:						
Through freight	51.40	54.50	36.2	38.4	142.0	141.0
Local and way freight	60.40	64.00	47.0	49.1	128.0	130.0
Railway passenger brakemen and flagmen	40.00	42.20	30.6	31.4	130.5	134.8
Railway freight brakemen and flagmen:						
Through freight	35.20	37.90	30.8	33.0	114.0	114.5
Local and way freight	42.20	45.20	40.8	42.7	103.5	106.0
Passenger enginemen and motormen	65.20	67.00	29.9	30.6	218.2	222.0
Freight enginemen and motormen:						
Through freight	57.50	62.80	34.4	37.5	168.0	168.0
Local and way freight	69.00	73.50	45.0	47.1	153.3	156.0
Passenger firemen and helpers	47.00	49.60	26.0	27.3	181.0	181.0
Freight firemen and helpers:						
Through freight	38.20	41.90	29.0	32.4	128.4	129.0
Local and way freight	45.75	49.25	38.9	41.3	117.5	119.0
Yard conductors and foremen	49.00	51.25	46.5	48.5	105.0	106.0
Yard brakemen and helpers	37.30	40.20	38.5	40.5	97.0	98.0
Yard enginemen and motormen	50.00	52.50	44.8	46.5	112.0	113.0
Yard firemen and helpers	34.15	36.70	38.7	41.2	88.3	88.5
Boilermakers	37.35	40.70	40.0	43.0	93.4	94.7
Carmen (C and D)	34.50	36.80	40.8	43.5	84.5	85.5
Machinists	37.50	40.20	40.8	43.3	92.0	94.3

flagmen in through train service whose average weekly earnings were $37.90. Then comes the yard brakemen and helpers with $40.20. The latter and yard firemen and helpers are the only two brotherhood groups who received less than $1 an hour for the straight time actually worked. The various groups of conductors and enginemen averaged from above $50 a week (yard conductors and firemen) to over $70 a week (way-freight enginemen and motormen).

One of the reasons cited by Mr. Robertson in justification for the demands for the 30 per cent basic wage increase is the rising cost of living. The Bureau of Labor Statistics of the Department of Labor publishes index numbers of the cost of living for the larger cities of the United States—an index the components of which are food, clothing, rent, fuel, electricity and ice, house furnishings, and miscellaneous, combined in the proportions common to the budgets of wage earnings and workers in the lower salary range. As of March 15, 1940, the index number stood at 99.8. As of February 15 of the current year it had risen to 100.8.

Improved Operation Reflects Better Mechanical Conditions

At the A. A. R. Mechanical Division annual meeting in St. Louis, Mo., last month, emphasis was placed on the desirability, and, in, fact, urgent necessity of railway mechanical department officers doing everything possible to assist in the rapid and safe handling of both industrial and national defense traffic on the rails. One of the reasons for present greatly improved freight handling records now being established by the railways is the fewer number of equipment delays chargeable to the development of locomotive and car defects on the road, and this achievement is definitely creditable to mechanical department supervisors and mechanical maintenance forces.

Increased motive power and car capacity, higher train speeds, more ton-miles handled per train hour, reduced repair costs and reduced unit fuel consumption, all are accomplishments in which the mechanical-department forces have played a predominant, or at least an important part. The accompanying table, for example, shows what has been done along this line by a single railroad in the 20-year period between 1920 and 1940, this railroad doubtless being by no means a rare exception. Freight-car repair costs on both an annual and a mileage basis have been reduced almost two-thirds and passenger-car repairs have been reduced 14 per cent. The factors entering into minimum expenditures for car repairs are well known and include preeminently the retirement of obsolete and worn-out cars and their replacement by new equipment which requires relatively little repair, particularly during the first few years of service life. In addition, improved design and construction and the use of more durable and more reliable structural materials have greatly extended the period between repairs and have consequently reduced costs.

Still another highly important factor in this reduction of car maintenance costs has, of course, been the concentration of repair operations in relatively few shops where, in general, more adequate modern equipment is available for performing the various reconditioning operations. Program repair work, improved welding technique and equipment and more accurate inspection and test methods also have contributed substantially to the reduction in car repair costs. By careful attention to the better mechanical conditions of trucks and journal boxes, and improved methods of reclaiming journal-box packing and oil, as specified by A. A. R. rules, the number of miles per hot box on the road in question has been increased about four times in passenger service and three times in freight service. What this means in the way of reduced delays to freight train and lessened operating cost may be readily appreciated.

As regards motive power, the influence of longer locomotive runs in boosting the potential service mileage between general repairs and intermediate terminal attention has greatly decreased unit costs. The way this works out may be illustrated by the following example: With a specified period of four years between flue and lagging removals, an intensive use of motive

Improvements in Operating Performance on One Railroad in Twenty Years

	1920	1939
Freight car repairs—cost per car	$203	$75
Freight car repairs—cost per mile	0.0166	0.0068
Passenger car repairs—cost per mile	0.0318	0.0273
All locomotive repairs—cost per mile	0.1933	0.1670
All locomotive miles per failure	12,433	66,561
Miles per hot box—passenger	450,493	1,862,397
Miles per hot box—freight	152,223	505,733
Freight train speed—miles per hour	10.3	16.4
Gross ton miles (trailing) per train hour	13,786	29,770
Gross tons (trailing) per train	1,343	1,820
Lb. coal per 1,000 gross ton-miles	150	118

power which enables the service mileage to be more than doubled in the period under consideration means that the cost per mile has been decreased at least 50 per cent. In addition, the high locomotive mileage between repairs implies high potential earnings. Among other things, improved locomotive design in conjunction with water treatment, cast steel underframes, welded construction, roller bearings, the improvement of shop facilities and up-to-date maintenance methods have greatly reduced the cost of locomotive repairs on a mileage basis, and greatly increased the number of locomotive miles per failure.

On the railroad referred to in the table, freight-train speeds increased roughly 60 per cent in the 20-year period indicated and gross tons per train increased 35 per cent, about 43 per cent increase in gross ton-miles per train hour being secured. In common with other railroads, this particular line has also reduced its unit fuel consumption substantially, due in no small measure to the improved condition of motive power and car equipment. Railroad mechanical supervisors and maintenance forces are therefore confronted with a definite

challenge to continue their good work and surpass previous accomplishments, if the expected peak movement of traffic this fall is to be handled successfully.

Diesel Locomotive Operating Costs

The sub-committee on the Development and Use of Oil-Electric locomotives of the A. A. R. Mechanical Division Committee on Locomotive Construction is to be congratulated on its decision to continue the study of operating costs of Diesel-electric locomotives and, above all, on the character of the comprehensive report which was presented at the St. Louis meeting. Here, for the first time is a collection of figures from which railroad men interested in the operation of this type of motive power may get information that is of real value.

The general character of the report has been improved over previous compilations of similar operating data in many respects. One of the most acceptable improvements is the presentation of the detailed figures by individual locomotives rather than by groups of locomotives of the same horsepower or type. Hardly less important is the actual date that each locomotive was placed in service and the total hours of operation since it first entered service. With data of this character it is now possible to eliminate a great deal of the speculation that had, of necessity, to be indulged in when endeavoring to analyze many of the tabulations of cost figures previously made.

An analysis of the cost of operation in the switching locomotive group discloses some interesting facts. The 49.8 cents per hour average for the 300-hp. group compares with the 37.5-cent average for the 600-hp. group and still leaves one in the speculative frame of mind because of the lack of detail figures broken down between Diesel engine, electrical equipment and mechanical equipment, as well as the fact that the average age of the locomotives in the relatively small group is approximately 12 years while the average age of the 600-hp. group is 3.6 years. The cumulative hours-of-service figure is, of course, much greater in the former group. Another interesting fact is that in the maintenance costs of the 600-hp. group a breakdown of charges indicates 58 per cent of the total for the Diesel engine repairs; 22 per cent for electrical repairs and 20 per cent for the mechanical equipment repairs. These figures check very closely with other studies of costs of 600-hp. locomotives and inspire confidence in the figures in the report. So, also, does the 37.5 cents-per-hour average check closely with other group cost studies.

One of the real objects of speculation is the reason why the 900-hp. group of switchers, having an average age of about three years, shows an average operating cost of 71.66 cents per hour as compared with 29.8 cents an hour for the 1,000-hp. group, the average age of which is less than two years. Unfortunately, the absence of a breakdown in the repair-cost figures obscures this important part of the analysis.

The value of the figures in this report is obvious and this value will increase immeasurably as each successive year's report—we hope—adds to the details and thereby removes future analyses from the field of guesswork. It is regrettable that the committee has not found it practical to include items for enginehouse expense and "other supplies" for these items will take on importance as the Dieselization of certain terminals approaches 100 per cent.

The cost figures on road motive power provide an excellent foundation upon which to build the statistics of future operation and as the volume of detail figures for this type of power increases so also will their value.

The sub-committee, in breaking down its costs to the basis of individual locomotives, has arrived early in its life at the point where steam locomotive "cost-accountants" should have been years ago.

New Books

STEEL CASTINGS HANDBOOK. *First Edition. Published by the Steel Founders' Society of America, 920 Midland Building, Cleveland, Ohio. Over 500 pages. Illustrated. Price, $2.*

This book is offered as a dependable manual on steel castings. It should be of great interest and value to railway mechanical engineers because, as stated in the book, about 35 per cent of the weight of the modern locomotive consists of steel castings and between 16 and 18 per cent of the modern freight car comprises cast steel parts. The purpose of the book is to give authoritative answers to questions on the manufacture, use and design of steel castings.

The several methods of producing steel for castings and the actual procedure used in making the castings, from pouring to the final testing operations, are given in detail. Following chapters on the physical values and heat treatment of cast steel there is an interesting discussion of the variables affecting the properties of steel castings. Among these variables are the manufacturing process, the shape and location of the test coupons, effect of mass and design, and the elements normally present in carbon cast steel.

The properties of carbon, low-alloy, heat- and corrosion-resistant and austentitic manganese cast steel are given in separate chapters. Suggestions on the preparation of specifications as well as the important features of the more widely accepted standard steel-casting specifications are set forth. Considerable information is included on design, pattern equipment and industrial uses of steel castings. The book has been brightened up by the liberal use of illustrations which not only add to the value of the text but help to make this first edition much more interesting than the usual engineering handbook.

THE READER'S PAGE

Who Saves Coal?

To the Editor:

When an unsolved problem stays on a person's mind for a considerable length of time, he is usually enabled, by the operation of the sub-conscious mind, to arrive at some conclusion that may be helpful.

He may cudgel his brains and walk the floor to no avail, but when he is out to lunch, or taking a swim on the beach, or doing some other incidental thing in the ordinary affairs of the day, with no consciousness whatever of his problem in mind, a thought will strike him between the eyes and, for a glowing moment, he has every angle dovetailed and the whole proposition laid out in its entirety in a beautiful array of facts that harmonize each with the other in a simplicity that leaves him wondering what he has been doing all these years.

Did anybody ever think there is a connection between one of Kipling's verses and the conservation of coal? Kipling wrote:

I keep six honest serving men
(They taught me all I knew);
Their names are *What* and *Why* and *When*
And *How* and *Where* and *Who*.

In applying this to coal conservation, we have:

What saves coal.
Why save coal.
When save coal.
How save coal.
Where save coal.
Who saves coal.

Every man on the railroad who has anything to do with our coal supply can give a pretty good answer to the first five of these questions—but not until we find the answer to "Who saves coal," will our monthly and annual reports reflect a decrease in this expense.

When each wielder of the scoop has made a saving in coal, he must be made to realize that he has done something very important and his effort must be recognized with sincere and hearty appreciation.

* * *

We hear a lot about supervision. That is all right up to a certain point (which is probably our present level), but past experience in coal-conservation campaigns has demonstrated beyond the shadow of a doubt that "hearty appreciation" accorded when deserved bears more fruit than the most intensive supervision with its detrimental attendant discipline.

N. A. Epperson.

Keeping the Record Straight

To the Editor:

On page 243 of the June issue of the *Railway Mechanical Engineer,* under the heading "Sir Nigel Gresley," it is stated that "The contributions to railway engineering for which Sir Nigel is best known are the three-cylinder single-expansion locomotive . . . and the combination valve motion by means of which the two outside valve gears provided motion for the valves of all three cylinders.

I have previously brought to your attention the fact that Mr. Gresley was not the inventor of the valve gear referred to. This was in the form of a letter which was published in the September, 1926, issue, page 701.

On January 11, 1910, United States Patent No. 946,-083 was issued to the writer and it contained the claim: "(1) In a three-cylinder fluid-pressure engine having one central and two side cylinders, the combination of two valve-operating mechanisms, each actuating the distribution valve of one of the side cylinders independently of that of the other and means for imparting the resultant of the independent movements of said valve mechanisms to the distribution valve of the central cylinder." It will be seen at once that this claim is basic and covers any form of mechanism which achieves the result sought.

About five years after this patent was issued Mr. Gresley adopted the principle and applied it to locomotives which he built for the London & North Eastern. Subsequently he took out an English patent to cover the particular form of mechanism which he applied to these locomotives.

In January, 1923, page 5, you published a letter from the well-known English engineer, H. Holcroft, in which he acknowledges my invention and in which he further states that the London & North Eastern was at that time still using three complete sets of valve gear on their three-cylinder locomotives.

When the writer designed and patented the valve gear for three-cylinder locomotives he was associated with the American Locomotive Company and under a ruling in force at that time he was required to give to the company the right to manufacture and vend the invention without compensation.

When about 1923 the American Locomotive Company began large scale manufacture and sale of three-cylinder locomotives on which they used valve gears covered by my patent, they elected to give all credit for the valve gear to Mr. Gresley, and the probabilities are that he also received compensation for its use.

As the patent has long since expired, discussion of it is more or less academic except as a matter of keeping the record straight.

H. S. Vincent.

Courtesy L. & N. Employees' Magazine

This car has been converted into a sand reservoir for supplying sand to Diesel-electric locomotives at East Louisville, Ky., on the Louisville & Nashville

High Spots in
Railway Affairs . . .

Collecting for Damages by Motorists

Some railroads have been quite successful in collecting for damage caused to their properties by motorists. F. A. Kelly, chief claim adjuster of the Santa Fe, in speaking before the Association of Railway Claim Agents, listed the items of expense which an automobile accident may cause a railroad. These are flat hourly and mileage charges for the use of wreck equipment, overhead, delays to traffic, cars demolished, supplies, fuel, lubricants, stores department expense, wages of labor and crews, extra wages of crews delayed, meals of wrecking crews, damage to equipment, loss of its use, rentals of equipment, flattened wheels, supervision, cargo loss, payroll tax, railroad retirement insurance, damage to freight, and loss of good will.

Freight Car Supply Problem

Railroad men sympathize with the problems that face the Car Service Division, A. A. R. W. C. Kendall, its chairman, pointed out in a recent address, "With each day comes some new demand with respect to car supply. There probably has never been a time when the problems relating to car handling were as varied as they are today. Six months ago the forecasters were prophesying a 9.4 per cent increase in car loadings in 1941. They could not then reckon with conditions which later arose. Subsequent revision raised this forecast to 12.5 per cent. For the year 1941 to date, the increase in loading volume over that of 1940 is 16.1 per cent. To what heights is it destined to reach? No one knows. Whatever it may be, it will require all the ingenuity we can bring to bear."

Car Loadings and Ton-Miles

We are accustomed to gage traffic trends and to make comparisons on the basis of the weekly freight car loadings figures. They have been showing a gratifying increase in traffic as compared to previous years, but apparently the statistics of "tons carried one mile" are much more impressive. The compilation of these figures, however, naturally lags far behind the car loading figures, which are available for the previous week on Thursday of each week. The Railway Age points out that for the first quarter of the present year the car loadings were 15 per cent greater than those of 1940, while the ton-miles figures were 19 per cent greater. This is due, in part, to better car loading, but probably more largely to the fact that the discontinuance of coastwise steamship service has made it necessary for the railroads to carry much more freight over extraordinarily long distances. This makes all the more notable the achievement of the railroads in handling the unusually great amount of freight traffic with a smaller number of freight cars, as compared to pre-depression years.

Subway Shelters in London

The Railway Gazette of London points out that while the number of shelterers in the London tube varies according to the German air activity over London and the phases of the moon, it was running at an average of about 70,000 a night in May. It has varied in recent months from 60,000 to 87,000 a night, with sleeping accommodations for 22,800 persons. Since the evening rush hour goes on until 6:30 p. m., the shelterers are asked to wait until it is over before coming to shelter. They are cautioned not to stand about in groups and to keep away from the platform edge. Several accidents have been caused by coming too near the trains. The shelterers are asked to keep their children under control and not to allow them to play on the escalators or in the lifts. A "Cockney crossword" was printed on the back of a leaflet containing the new set of rules.

Stop This Economic Waste

The railroads of the United States and Canada paid out $21,059,149 for freight loss and damage in 1940, an increase of 11.5 per cent over the preceding year. This is in line with the increase in the volume of transportation, particularly manufactured goods. The Freight Claim Division of the A. A. R. is intensifying its drive to reduce this great economic waste. It points out that, "There is more opportunity for errors when shippers and transportation companies are working under high pressure and increasing business. Therefore, plans are being formulated for greater supervision in all phases of freight handling, from the shipping room to the receiving room. This will include special methods of educating the personnel, a large number of whom are new. Special studies are also being made of loading methods to apply to the many articles to be used in national defense, the most important of which represents a wide variety of machinery products that must be handled promptly and safely. This will be emphasized in all its ramifications, and lends double importance to the joint shipper-carrier perfect shipping and careful handling campaign."

Women Cannot Lift Heavy Loads

Women on the British railways have had to replace express handlers who have been called into active service. The London & North Eastern Railway has issued a leaflet urging shippers to use smaller packages when sending them by passenger train. It includes two illustrations, one showing two women handling comparatively small packages, with the caption, "Smaller parcels—quicker transit." The other shows two women struggling to unload a heavy bale from a baggage compartment, bearing the caption, "This means delay." The leaflet points out that "Railwaymen liberated for the fighting forces are being replaced by women. Women cannot be expected to lift such heavy loads as men. Parcels must be handled expeditiously at stations and junctions. The smaller and lighter each parcel, crate or box, the quicker the service. Make your packages small and light and help in this way to speed the trains and the national effort."

Harriman Safety Awards

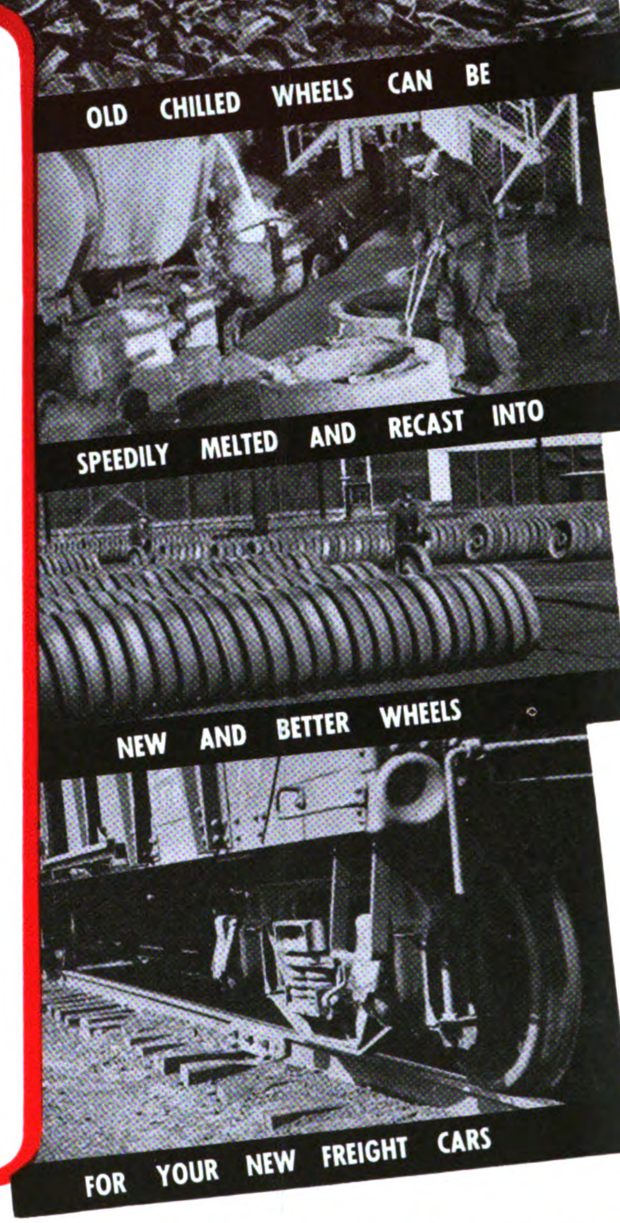
The Harriman Safety Awards for the best records in 1940 in their respective classes were presented on June 17 to the Norfolk & Western, in the class operating ten million locomotive-miles or more a year; the Ann Arbor, for the class operating between one and ten million locomotive-miles annually, and to the Missouri-Illinois in the group operating less than one million locomotive-miles annually. Col. John Stilwell, president of the American Museum of Safety, under whose auspices the awards were made, pointed out that passengers were three times as safe during the last ten years as they were in th 20's, six times as safe as compared with the period 1910-19, and fourteen times safer than in the first ten years of the century. Judge R. V. Fletcher, vice-president and general counsel of the Association of American Railroads, who conferred the awards, presented what he called a "brain wave" based on "my own mathematics," to the effect that the average American citizen could ride on a passenger train, traveling 50 miles an hour, 24 hours a day, and go 4,000 years before an accident occurs.

(*Turn to second left-hand page*)

<u>YOU</u> Can Help Us Speed Deliveries of Your NEW CHILLED WHEELS

HOW? . . . By making sure that every chilled wheel you scrap is returned at once to one of our foundries for conversion.

The wheel exchange plan, by which you receive new wheels for old on a conversion charge basis, makes this, not only the most economical, but also the fastest possible way for you to obtain the new wheels so vitally needed to keep Defense Production rolling to its destination.



ASSOCIATION OF MANUFACTURERS OF CHILLED CAR WHEELS

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- Uniform Inspection
- Uniform Product

NEWS

Doctors' Degree Conferred on Hankins, McCormick, and Nystrom

THREE high-ranking mechanical officers of American railroads were awarded honorary doctorate degrees during the week beginning June 9. Fred W. Hankins, assistant vice-president (operating) of the Pennsylvania and past chairman of the Mechanical Division, Association of American Railroads, was awarded an honorary degree of Doctor of Science by Bucknell University, Lewisburg, Pa.

George McCormick, general superintendent motive power, Southern Pacific and Northwest Pacific, was awarded an honorary degree of Doctor of Engineering by the Agricultural & Mechanical College of Texas, College Station, Tex.

Karl F. Nystrom, mechanical assistant to chief operating officer, Chicago, Milwaukee, St. Paul & Pacific, was awarded an honorary degree of Doctor of Engineering by Marquette University, Milwaukee, Wis., on June 11. Mr. Nystrom was cited, among other things, for his development work in the design and construction of modern passenger train equipment. Coming to the Milwaukee in 1922 as an engineer of car design he revolutionized shop techniques on the road and designed and built in company shops lightweight rolling stock for the "Hiawatha" trains.

Load Per Car of Carload Freight Averages New High

A NEW high record in the average load per car of all freight transported in carload lots was established by Class I railroads in 1940, according to the Association of American Railroads.

In that year, an average of 37.7 tons per car for all commodities carried in carload lots was attained. This was an increase of nine-tenths of a ton, compared with the previous record established in 1939. The increase of nearly one ton in the average load was equivalent to the addition of 26,000 freight cars to the available car supply, the A. A. R. said.

Preference Rating for Freight Cars

BECAUSE of "a growing tightness" in the supply of freight cars, a limited blanket rating has been extended to 60 car builders which will aid them in obtaining scarce materials and thereby speed up their production schedules, according to an announcement by E. R. Stettinius, Jr., director of priorities, Office of Production Management, on June 19.

The rating provided in the order is A-3. This, it is explained, puts the requirements for freight-car construction and repairs behind the top needs in the A-1 classes, but puts them ahead of the less essential needs with lower ratings. The order provides that the rating can be used to facilitate the obtaining of material and equipment entering into freight-car construction, including railroad, industrial and mine freight cars. The order, it is further declared, is similar to the limited blanket rating already extended to airplane makers and builders of ships for the Maritime Commission merchant vessel program.

Car builders who use the rating, including railroads which build their own cars, can extend it to their suppliers by executing copies of the order and serving it on their sub-contractors, who, in turn, can extend the rating to their own suppliers by going through the same procedure.

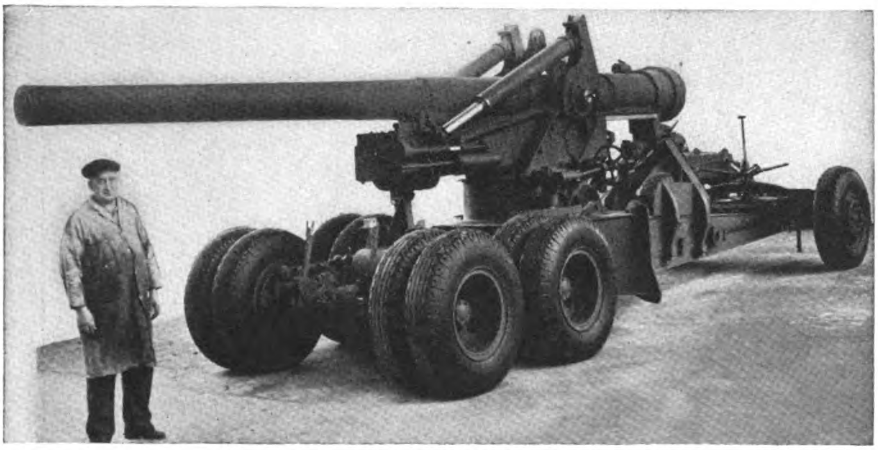
In a letter accompanying the order, car builders were urged to substitute non-scarce materials for critical items wherever possible. It was suggested that wood be substituted for critical metals wherever possible and that, in addition, the car builders specify sizes and thicknesses of steel sheets and plates so as to minimize production difficulties.

The rating extended to the car builders applies not only to orders for critical materials but also to orders for cutting and other perishable tools and equipment, it was stated. The rating does not cover machine tools, however, and the rating for machine tools and similar production machinery must be obtained in the usual manner by application for preference rating certificates.

"You will employ extreme care in making use of this privilege (the preference rating) and the extension of the same to your suppliers," wrote Mr. Stettinius to the car builders, "and you will emphasize proper scheduling in the ordering of necessary material." It was also explained that the general preference order is applicable to material and equipment entering directly or indirectly at any state of construction, into the construction of freight cars by the producers who are granted the use of the A-3 rating.

The new action, states the announcement, follows a study in which it was shown that the national defense program has placed heavy demands upon the country's rail transportation system. This, in turn, has placed a corresponding burden upon producers of freight cars. Moreover, the production of materials necessary for defense has also greatly increased the demand for cars used in mines and industrial plants, according to Mr. Stettinius. Because of these facts, the minerals and metals group of the priorities division recommended that a general priorities system be established to assure freight-car producers of adequate deliveries of materials and equipment to meet their needs.

"It is expected," concludes the announcement, "that the use of this order will greatly facilitate freight-car building, will assure the builders of a constant flow of adequate supplies and will thereby facilitate the overland transportation of national defense materials."



The American Locomotive Company delivered the first 155 mm. gun carriage produced by private industry to government officers at its Dunkirk, N. Y., plant on May 15—The order was placed August 8, 1940 and the carriages are now in line-production at this plant—Weight, 20,000 lb.; top speed, 75 m. p. h.

D. & R. G. W. Streamline "Prospector" Trains

Two stainless steel Diesel-electric passenger trains, to be known as the Prospector, will be placed in overnight operation by the Denver & Rio Grande Western between Denver, Colo., and Salt Lake City, Utah, about the first of August. The trains, which are being built by the Edward G. Budd Manufacturing Company, will each consist of two cars.

Several new features will be incorporated in the trains. These include electrically operated disc brakes equipped with an electric device to prevent the sliding of wheels,

a hot-water heating plant, which secures its heat from the water in the jackets of the Diesel engines and horizontal-type Diesel-electric power plants. Each car will be a self-contained unit and each will be driven by two Hercules Diesel engines, synchronized so that they will operate in unison by a single control lever in the cab. Each axle will have an individual power drive to provide uniformity of traction.

Each train will contain reclining coach seats, sleeping sections, cabinettes (private rooms), and diner-lounge space. The trains will be air-conditioned throughout by electric-mechanical refrigeration.

Fall Car Supply

Assuming Association of American Railroads' estimates of next fall's carloading peak to be correct, the railroads must make further improvements in car utilization if tight situations or indeed actual shortages are to be avoided, according to data placed before the chief operating officers attending the May 26 Chicago meeting called by C. H. Buford, vice-president of the A. A. R. in charge of the Operations and Maintenance Department. The data assumed a carloading peak of 932,100 cars, and calculated the number of cars required to handle that business on the basis of car turnaround periods ranging from 11.8 days to 12.8 days.

On the basis of the present turnaround time—12.4 days—and assuming other factors remain unchanged, there is an indicated shortage of 65,005 cars. In other words, it was estimated that there will be 1,586,143 cars in serviceable condition next October; but 1,651,148 cars would be required to handle 932,100 car loads when the turnaround time was 12.4 days. To meet the estimated peak the turnaround time would have to be cut to about 11.9 days; then 932,100 car loads could be handled with 1,584,570 cars.

But it is not the purpose of the industry to leave the turnaround time or other efficiency factors unchanged, as discussions at the meeting indicated. There was recognition of the fact that the carriers must continue to do a satisfactory job if certain groups ready to plug for government operation are to be disappointed and made mute. Thus the suggested set of principles governing the handling of equipment in the interest of elimination of car waste which came out of the meeting, and other like proposals brought out in the discussion.

The suggested set of principles includes 14 items relating to the more efficient handling of carload freight, and a like number relating to l. c. l. traffic. Among the latter are those calling for a review of the possibilities of substituting motor-truck service for branch line and intra-terminal switching operations. It was pointed out in the former connection that the Pennsylvania operates 107 station-to-station truck routes, saving 535 box cars daily, while a daily saving of 1,000 cars results from P. R. R. trucking in lieu of intra-terminal switching.

In the data which was placed before the chief operating officers, the estimate of 1,586,143 serviceable cars for next October 1 is built up as follows: Ownership on May

(*Continued on second left-hand page*)

Orders and Inquiries for New Equipment Placed Since the Closing of the June Issue

Locomotive Orders

Road	No. of Locos.	Type of Locos.	Builder
Atlantic Coast Line	9	2,000-hp. Diesel-elec.	Electro-Motive Corp.
Boston & Maine	2	1,000-hp. Diesel-elec.	Electro-Motive Corp.
	2	660-hp. Diesel-elec.	
Canadian National	15	1,000-hp. Diesel-elec.	Electro-Motive Corp.
	5	1,000-hp. Diesel-elec.	American Loco. Co.
	35	4-8-4	Montreal Loco. Wks.
Canadian Pacific	20	4-6-2	Canadian Loco. Wks.[1]
Conemaugh & Black Lick	2	0-8-0	Lima Loco. Wks.
Great Northern	3	600-hp. Diesel-elec.	Electro-Motive Corp.
	10	1,000-hp. Diesel-elec.	
	1	2,700-hp. Diesel-elec. frt.	
	2	4,050-hp. Diesel-elec. frt.	
	2	1,000-hp. Diesel-elec.	Baldwin Loco. Wks.
Kansas City Southern	2	2,000-hp. Diesel-elec.	Electro-Motive Corp.
Louisville & Nashville	4	660-hp. Diesel-elec.	Baldwin Loco. Wks.
	4	660-hp. Diesel-elec.	American Loco. Co.
	4	660-hp. Diesel-elec.	Electro-Motive Corp.
Nashville, Chattanooga & St. Louis	10	4-8-4	American Loco. Co.
	2	660-hp. Diesel-elec.	
	1	660-hp. Diesel-elec.	Baldwin Loco. Wks.
	1	1,000-hp. Diesel-elec.	
	1	660-hp. Diesel-elec.	Electro-Motive Corp.
	1	1,000-hp. Diesel-elec.	
New York Central	7	600-hp. Diesel-elec.	Electro-Motive Corp.
	1	600-hp. Diesel-elec.	Baldwin Loco. Wks.
	7	350-hp. Diesel-elec.	General Elec. Co.
	15	4-8-2	American Loco. Co.
New York, Chicago & St. Louis	15	2-8-4	Lima Loco. Wks.
Pennsylvania	12	21,000-gal. tenders[2]	Co. shops
Portland Terminal Co.[3]	1	1,000-hp. Diesel-elec.	American Loco. Co.
	1	660-hp. Diesel-elec.	
Union Pacific	20	4-6-6-4	American Loco. Co.
United States Interior Dept.	1[4]	4-8-2	Baldwin Loco. Wks.
United States Navy Dept.	2	50-ton Diesel-elec.	General Elec. Co.
United States War Dept.	4	60-ton Diesel-elec.	General Elec. Co.
	1	45-ton Diesel-elec.	
	5[5]	2-8-2	American Loco. Co.
Western Pacific	3	5,400-hp. Diesel-elec.	Electro-Motive Corp.

Locomotive Inquiries

Road	No. of Locos.	Type of Locos.	Builder
Argentine Naval Commission	1	2-8-2	
Central of New Jersey	2	1,000-hp. Diesel-elec.	
	8	600-hp. Diesel-elec.	
Clinchfield	10	4-6-6-4	
Louisville & Nashville	18-22	Steam pass.	
Pennsylvania	2 or 3[6]	0-6-0	

Freight-Car Orders

Road	No. of Cars	Type of Car	Builder
Atchison, Topeka & Santa Fe	2,000	Box	Pullman-Standard
Baltimore & Ohio	1,000	Box	Pullman-Standard
Boston & Maine	200	40-ton box	Magor Car Corp.
	500	50-ton flat bottom gond.	Bethlehem Steel Co.
	100	50-ton twin hopper coal	
Chicago & Eastern Illinois	500	50-ton box	Mt. Vernon Car Mfg.
Chicago, Rock Island & Pacific	800	50-ton box	Pressed Steel Car
Delaware & Hudson	35	70-ton container	American Car & Fdry.
Elgin, Joliet & Eastern	250	70-ton side dump hopper	American Car & Fdry.
	250	70-ton side dump hopper	Ralston Steel Car
Erie	5	90-ton flat	Greenville Steel Car
Great Northern	1,000	50-ton box	Pullman-Standard
	500	50-ton box	Pressed Steel Car
	500	50-ton box	General American
Gulf, Mobile & Ohio	850	40-ton box	American Car & Fdry.
	150	50-ton hopper	
Kansas City Southern	200	50-ton box	Pullman-Standard
Lehigh & New England	300	50-ton coal	Pressed Steel Car
	100	70-ton covered hopper	American Car & Fdry.
Lehigh Valley	500	Gondolas	Bethlehem Steel
	400	50-ton box	Pressed Steel Car
	100	55-ton auto box	American Car & Fdry.
Maine Central	400	40-ton box	Magor Car Corp.
	100	50-ton coal	Bethlehem Steel
	10	70-ton covered hopper	American Car & Fdry.
Midland Valley	5	50-ton box	Mt. Vernon Car Mfg.
Missouri Pacific	50	70-ton covered hopper	Mt. Vernon Car Mfg.
	200	50-ton automobile	
	800	50-ton box	American Car & Fdry.
Nashville, Chattanooga & St. Louis	500	Box	Pullman-Standard
	300	Gondola	
New York Central	1,000	50-ton box	[6]
	500	70-ton gondola	Despatch Shops
Norfolk & Western	1,000	70-ton hopper	Virginia Bridge
	500	70-ton hopper	Bethlehem Steel
Northern Pacific	1,350	50-ton box	American Car & Fdry.
	200	Ballast	
	500	Box	Pullman-Standard
Pennsylvania	2,700	50-ton hopper	[2]
	2,000	50-ton box	
	800	70-ton gondola	
	500	70-ton covered hopper	Co. shops
	10	125-ton flat	
	10	125-ton well	
Reading	500	70-ton gondola	Bethlehem Steel
Southern	100	70-ton cement	Greenville Steel Car
United States Army & Navy Munitions Board	4	70-ton flat	Greenville Steel Car
Wabash	1,000[7]	Box	Co. shops
	15	70-ton cement	American Trans. Corp.
Wabash Car & Equip. Co.	10	70-ton covered hopper	American Car & Fdry.
Western Maryland	200	Box	Pressed Steel Car
	300	Hopper	Bethlehem Steel
	200	Gondola	Greenville Steel Car
	25	Flat	
Western Pacific	350	50-ton box	Mt. Vernon Car Mfg.
	300	50-ton flat	

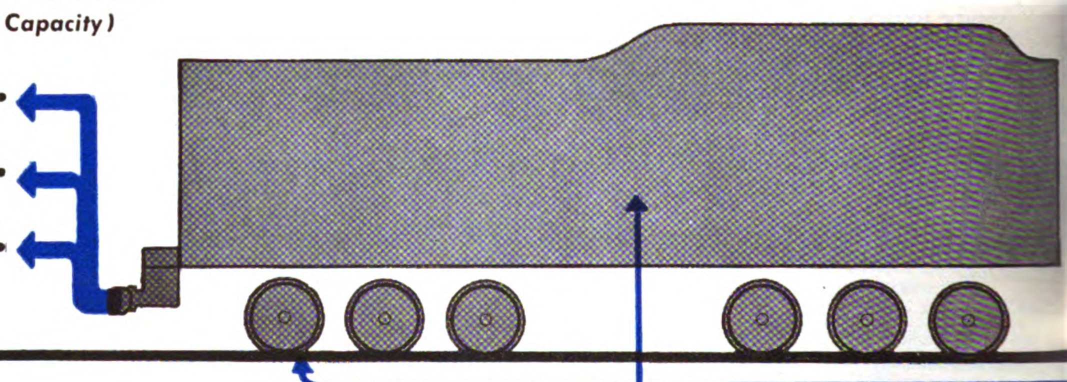
(*Continued on second left-hand page*)

33 1/3% increase in
(WITHOUT INCREASING THE SIZE OF THE LOCOMOTIVE)
by application of...

The steam locomotive is possessed of latent power which now can be released by The Franklin System of Steam Distribution. This system, which is applicable to existing as well as new steam locomotives, is the result of years of experimentation, research and road tests and is offered to the railroads as a means of increasing train speed and load capacity without increasing the size of the locomotive.

INCREASED DRAWBAR HORSEPOWER
(For "Train Load-Speed" Capacity)

24% AT 50 M.P.H.
33% AT 60 M.P.H.
44% AT 70 M.P.H.



FUEL AND WATER CONSUMPTION ARE NOT INCREASED.

REG. U.S. PAT. OFF.

FRANKLIN RAILWAY SUPPLY
In Canada: Franklin Railway

Freight-Car Inquiries

Akron, Canton & Youngstown	100	50-ton hopper
	30	70-ton gondola
Central of Georgia	150	50-ton auto box
	50	50-ton box
	50	50-ton flat
Central of New Jersey	500-1,000	70-ton gondolas
Chicago, Rock Island & Pacific	800-1,000	50-ton box
	200-250	50- or 70-ton coal
Chicago, St. Paul, Minneapolis & Omaha	1,000	50-ton box
	250	50-ton gondola
Delaware, Lackawanna & Western	750	50-ton box
Denver & Rio Grande	100	70-ton flat
New York Central	750	50-ton box
	250	55-ton box
	500	70-ton gondola
Sanderson & Porter Co.	50	50-ton box
Seaboard Air Line	1,000	50-ton box
	100	Flat
	100	70-ton hopper
	50	Covered hopper
Southern Pacific	2,100	Box
	500	Auto-box
	700	Gondola
	300	Flat
	250	Tank
	150	70-ton hopper
Wabash	100	70-ton gondola

Passenger-Car Orders

Road	No. of Cars	Type of Car	Builder
Atlantic Coast Line	8	Coaches	Edw. G. Budd
	3	Coach-bagg.-dorm.	
	1	Dining-lounge	
	2	Tavern	
	2	Dining	
Chicago, Indianapolis & Louisville	7	Baggage	St. Louis Car
Erie	7	Bagg.-exp.	American Car & Fdry.
Nashville, Chattanooga & St. Louis	10[8]	Parlor	Pullman Co.
Western Pacific	4	Chair	Edw. G. Budd

[1] Order incorrectly reported in the June issue as having been placed with the Montreal Locomotive Works.
[2] For early 1942 delivery. The Pennsylvania equipment program, comprising 15 electric locomotives designed both for passenger- and freight-train service, 12 steam locomotive tenders, 6,020 freight cars, and 50 cabooses, will cost more than $23,000,000.
[3] A joint affiliate of the Boston & Maine and Maine Central.
[4] For the Alaska Railroad. To cost $110,000.
[5] These locomotives were incorrectly reported as 2-6-2 type in the June issue. They are for service in Newfoundland.
[6] Unconfirmed.
[7] Building authorized by court; cost, $3,388,000.
[8] Used cars to be converted into day coaches.

1 was 1,646,956 cars; add thereto 56,502 cars now on order; subtract therefrom 25,-000 cars to be retired from May 1 to October 1; gives 1,678,458 cars, representing approximate ownership on October 1. Then it was assumed that bad order cars would amount to 5.5 per cent of ownership, reducing the total serviceable to the 1,586,-143. The calculations as to the number of cars required on the basis of different turnaround periods were set up for an assumed weekly peak of 995,500 cars as well as the 932,100 mentioned at the outset. If the peak reached the former proportions, while the turnaround time remained at 12.4 days and other factors remained static, it would require a supply of 1,763,457 serviceable cars to handle the business.

Wages Before Cars, Union Chief Says

So that railroad employees will not have to forego "the righteous increase in income necessary to take care of rising costs of living," the cars and equipment required solely for national defense should be paid for by the taxpayers. This is the proposal made by President D. B. Robertson of the Brotherhood of Locomotive Firemen & Enginemen in an article to appear in the July issue of the union's magazine entitled "Railroad Wages—One Million Americans Can't Be Wrong." Writing to justify the recent demands by the transportation and non-operating unions for a basic wage increase of 30 per cent, the brotherhood chief declares at the outset that "railroad wages are not high and they have not kept pace with those paid in similar industries." That the idea of increased rates and fares may be involved in the subject is indicated by his statement that "the plight of the railroad employee as a class deserves more consideration from the public than he has enjoyed up to this time."

Discussing the ability of the carriers to absorb the burden of increased wages, Mr. Robertson argued that: "With carloadings promising to reach an all-time high by the end of this year, rail earnings are skyrocketing and will in all probability exceed the billion dollar mark." And elsewhere, "Labor demands an increased participation in today's railroad prosperity. Labor's unit of productivity has increased about 43 per cent in the past four years and it now demands a share. If workers did not share in the benefits flowing from improved efficiency and technological improvements, there would be no advance in the standard of living."

An editorial which appeared in the Railway Age of May 31 characterizing the move for increased wages as "just plain suicide for both the railroads and their employees" comes in for rough treatment in the article. Of the stand taken by Railway Age that the railroads need money to buy equipment for national defense, he writes in part:

"This is a self-respecting democratic government. It pays for what it gets. It is foreign to our way of thinking to believe that the government would expect railroad labor to continue along at inadequate wages so that it could donate towards the purchase of additional equipment made necessary by national defense efforts. In all other industries, the government is quite willing to pay, and does pay, the cost of extra equipment required by reason of national defense demands. If more cars and equipment are required solely for national defense, then that is a legitimate expense of national defense and should be treated as such. The burden should not be put upon the workers in the industry, who with their families, represent about five million people."

A. S. M. E. Officers Nominated

Nominations for 1942 officers of the American Society of Mechanical Engineers were announced on June 19 by A. L. Kimball, chairman of the regular nominating committee which held sessions during the semi-annual meeting of the society in St. Louis, Mo., June 16 to 19, inclusive. Names presented by the committee are: President, J. W. Parker, vice-president, Detroit Edison Company; Vice-Presidents: C. F. Freeman, vice-president, Manufacturers Mutual Fire Insurance Company; C. B Peck, managing editor, *Railway Mechanical Engineer* and mechanical department editor, Railway Age; W. H. Winterrowd, vice-president, Baldwin Locomotive Works, and W. R. Woolrich, dean of engineering and director, Bureau of Engineering Research, University of Texas; Managers: W. G. Christy, smoke abatement engineer, Hudson county, N. J.; H. L. Eggleston, manager, Gas and Refining departments, Gilmore Oil Company, and T. S. McEwan, resident manager-engineer, McClure, Hadden & Orthan.

U. P. Shops at Cheyenne Damaged by Fire

Damage, estimated at $1,000,000, was caused by a fire in the Cheyenne, Wyo., shops of the Union Pacific on May 19. The fire was thought to have started in the wheel shop, from which it spread to other buildings covering a block and a half. The enginehouse, locomotive shop and office building were not damaged.

Old Employees Guests of Lima Locomotive Works

Two hundred ninety employees of the Lima Locomotive Works, Inc., with service records of 25 or more years, guests of the company at dinner at Lima, Ohio, on June 10, were told by H. O. Bentley, the company attorney, in a brief address, that they were participating in a level of material prosperity that their children and children's children would never know. He urged them to "keep a tight hold on their chairs" and to avoid the hysteria which in some localities is creating a state of anarchy in industries essential to national

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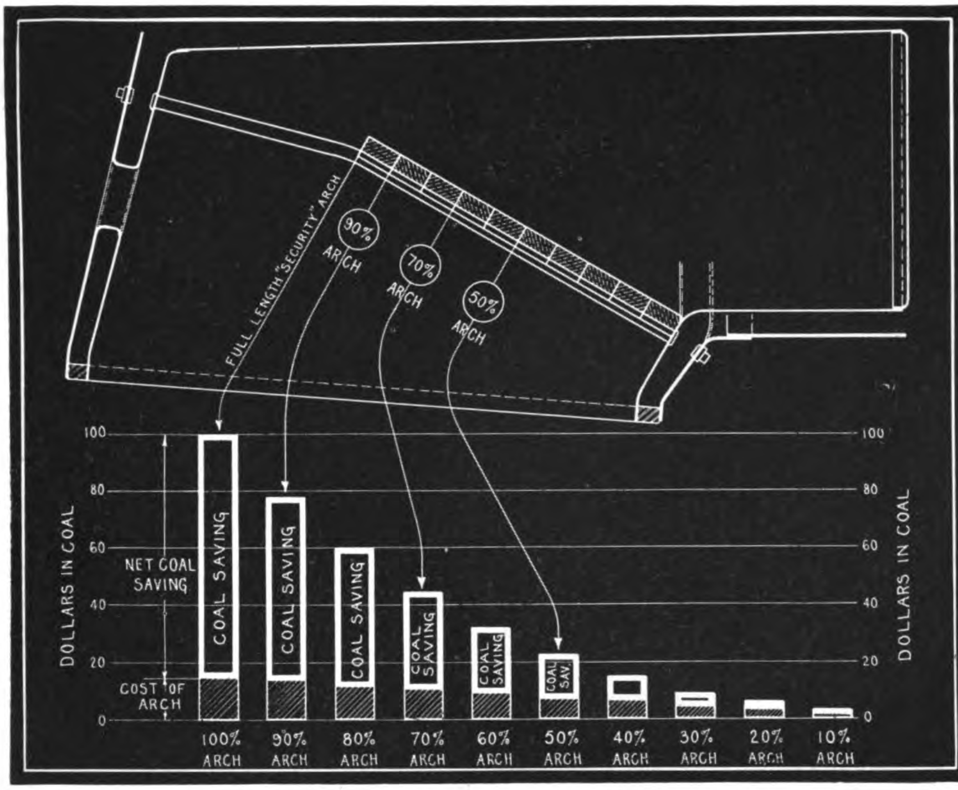

THE EFFECT OF ABBREVIATED ARCHES ON FUEL SAVING

LET THE ARCH HELP YOU SAVE

With the emphasis being placed on saving every railroad dollar, the locomotive Arch becomes increasingly important.

Regardless of the amount of traffic handled, the locomotive Arch saves enough fuel to pay for itself ten times over.

Be sure that every locomotive leaving the roundhouse has its Arch complete with not a single brick nor a single course missing.

In this way, you will get more work for each dollar of fuel expense. Skimping on Arch Brick results in a net loss to the railroad.

THERE'S MORE TO SECURITY ARCHES THAN JUST BRICK

HARBISON-WALKER REFRACTORIES CO.

Refractory Specialists

AMERICAN ARCH CO.
INCORPORATED
60 EAST 42nd STREET, NEW YORK, N. Y.

Locomotive Combustion Specialists

defense. During the dinner, at which Samuel G. Allen, chairman of the board, presided, gold-and-enamel pins were presented to the 25-year-and-up employees who represent nearly 12 per cent of the total payroll.

Felicitations were extended by John E. Dixon, president, and L. A. Larsen, vice-president, of the company, and H. F. Ball, president of the Franklin Railway Supply Company, who has been a director of Lima for 25 years.

Willkie Pays High Tribute to Sam Pryor, Jr.

Wendell L. Willkie, in a brief address at a luncheon to Samuel F. Pryor, Jr., held at the Hotel Commodore, New York, on June 23, paid high tribute to Mr. Pryor's qualities as a friend and "the most regular fellow" it had been his pleasure to meet. The luncheon, presided over by Charles A. Braden, general traffic manager of the National Distillers Products Corporation, and attended by over 350 railway, railway supply, and industrial traffic men, was on the occasion of Mr. Pryor's leaving the railway supply field to enter air transport as vice-president and assistant to the president of the Pan American Airways Corporation. Others who spoke were William F. Cutler, president of the Southern Wheel Division, American Brake Shoe and Foundry Company, to whom Mr. Pryor had been assistant; Juan T. Trippe, president and general manager, Pan American Airways Corporation, and Charles C. Hubbell, general purchasing agent, D. L. & W.

In response to his tribute, Mr. Pryor, who was Republican national committeeman from Connecticut, declared that Mr. Willkie stood for all that free enterprise means and that if we do not protect it, our form of government will fail. He added that this is the only reason why he has been in politics.

Equipment Purchasing and Modernization Programs

Atlantic Coast Line.—The A. C. L. has asked the Interstate Commerce Commission for authority to assume liability for $7,880,000 of equipment trust certificates, maturing in 10 equal annual installments of $788,000 on July 1 in each of the years from 1942 to 1951, inclusive. The proceeds will be used as part of the purchase price of new equipment costing a total of $8,762,000 and consisting of 1,600 all-steel, wood-lined, single door, 50-ton box cars; 700 all-steel, wood-lined, 50-ton automobile box cars; 300 all-steel, wood-lined, 50-ton furniture-automobile box cars; 200 all-steel, wood floor, high side, 50-ton gondola cars, and 100 all-steel, 70-ton phosphate cars. Orders for this equipment were reported in the June issue.

Atchison, Topeka & Santa Fe.—A contract has been awarded the Ellington-Miller Company, Chicago, for the construction of additional facilities in the Eighteenth Street yard at Chicago, as follows: Fuel-oil facilities for steam locomotives, Diesel-oil facilities for Diesel locomotives, engine-washing platforms, drain lines, concrete platforms in the coach yard and two repair pits at the Diesel shop. The contract for the electrical work in connection with these facilities was awarded to the Super Electric Construction Company, Chicago. The total cost of the work will be approximately $200,000.

Canadian Pacific.—A contract for a one-story machine shop at Calgary, Alta., has been awarded the Poole Construction Co., Ltd., Edmonton, Alta. The building will occupy an area of 90 ft. by 160 ft. and will have a steel frame and brick walls. Two repair tracks will extend through the building and a 20-ton overhead crane and a drop pit table will be installed. The approximate cost of the building will be $95,000.

Central of Vermont.—The Central of Vermont is reported to be contemplating the purchase of 50 box cars of 40 tons' capacity.

Chesapeake & Ohio.—The C. & O. has asked the Interstate Commerce Commission for authority to assume liability for $3,100,000 of equipment trust certificates, bearing interest at not more than 2½ per cent and maturing in 10 equal annual installments on June 15 in each of the years from 1942 to 1951, inclusive. The proceeds will be used as part of the purchase price of new equipment costing a total of $3,961,339 and consisting of 10 class H-8 freight locomotives of the 2-6-6-6 type with 25,000 gallon tenders; 8 class L-2 passenger locomotives of the 4-6-4 type with 21,000 gallon tenders; and 2 class J-3-A passenger locomotives of the 4-8-4 type with 22,000 gallon tenders. Orders for the 4-6-4 and 4-8-4 type locomotives were reported in the March issue.

The road is reported to be in the market for 2,000 freight cars comprising 1,000 box cars of 50 tons' capacity and 1,000 hopper cars of 50 tons' capacity.

Chicago & North Western.—The C. & N. W. has asked the Interstate Commerce Commission for authority to assume liability for $2,325,000 of equipment trust certificates, maturing in annual installments beginning July 1, 1942, and ending July 1, 1951, inclusive. The proceeds will be used as part of the purchase price of new equipment costing $3,100,000 and consisting of 1,000 50-ton, 40-ft. 6-in., all-steel box cars. Orders for this equipment were announced in the June issue.

Chicago, Burlington & Quincy.—Directors of the Burlington have approved a 1942 equipment program calling for the construction of 4,425 freight cars in its shops at Galesburg, Ill., and Havelock, Neb., for the Burlington, the Colorado & Southern and the Ft. Worth & Denver City. The purchase of locomotives and passenger-train cars is still being considered. The freight cars to be constructed in 1942 are as follows:

	C. B. & Q.
300	53½-ft. 50-ton flat
250	50-ton hopper
200	40-ton stock
70	65-ft. mill type gondola
50	70-ton all-steel covered hopper
250	70-ton hopper
1,500	40½-ft. 50-ton steel sheathed box
500	50-ft. 50-ton steel sheathed box
175	50-ft. automobile with loading devices
3,295	
	C. & S.
100	53½-ft. flat
30	65½-ft. mill type gondola
500	40½-ft. 50-ton steel sheathed box
630	
	Ft. W. & D. C.
500	40½-ft. 50-ton steel sheathed box

Chicago, St. Paul, Minneapolis & Omaha.—The C. St. P. M. & O. has ap-

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* * *

Twelve-ton light combat tanks roll off the assembly line of the American Car and Foundry Company's plant at Berwick, Pa., at the rate of nine tanks per day. By July 15 rate will be 15

plied to the Interstate Commerce Commission for approval of a sale to the Reconstruction Finance Corporation of $1,680,000 of 2½ per cent equipment trust certificates at par and accrued dividends. The certificates, dated July 1, 1941, would mature in 15 equal annual installments on July 1 of each year from 1942 to 1956. The transaction would finance the acquisition from the American Car & Foundry Company of 700 all-steel box cars of 50 tons' capacity. The order for this equipment was announced in the April issue.

Florida East Coast.—The F. E. C. is reported to be contemplating the purchase of several Diesel-electric locomotives.

Grand Trunk Western.—The G. T. W. has asked the Interstate Commerce Commission to approve a plan whereby it would issue and sell to the Reconstruction Finance Corporation $5,692,000 of 2½ per cent equipment trust certificates, maturing in 20 semi-annual installments on June 1 and December 1 in each of the years from 1942 to 1951, inclusive. The proceeds will be used as part of the purchase price of new equipment costing a total of $7,116,150 and consisting of 25 U-3-b northern type steam locomotives; 20 Diesel-electric locomotives; 300 all-steel, 40-ton automobile cars; 200 all-steel, 70-ton gondola cars, and 100 all-steel, 70-ton flat cars. Orders for the freight cars were announced in March.

Great Northern.—A system-wide maintenance, improvement and equipment program for 1941, involving an expenditure of $48,500,000 and affording summertime employment to an additional 4,000 men, has been announced by the Great Northern. The program, which already is underway in the ten states in which the company operates, provides for: Maintenance of way, structures and equipment—$25,135,000; additional facilities and improvements to existing facilities and equipment—$5,793,000; purchase of new equipment—$17,498,000.

This year's maintenance and improvements will be a continuation of a program begun several years ago, said F. J. Gavin, president, but will cost substantially less than in 1940, and will be approximately $1,000,000 under the average annual expenditures for maintenance work in the five-year period, 1936 through 1940. However, Mr. Gavin added that the national defense program has increased demands for cars and motive power, necessitating purchases of more new equipment than in 1940.

New equipment listed in this year's program includes: 4,000 new box cars, half of which were received the first quarter of this year, with delivery of the remaining 2,000 scheduled to begin in October (order reported elsewhere in this issue); 20 Diesel-electric locomotives of varied power for switching and road service throughout the system, and 15 N-3 type steam locomotives. The latter engines are now under construction in Great Northern shops. An order for two Diesel-electric locomotives was announced in January; orders for 18 are announced elsewhere in this issue.

Louisville & Nashville.—The L. & N. has asked the Interstate Commerce Commission for authority to assume liability for $4,970,000 of equipment trust certificates, maturing in 10 equal annual installments of $497,000 on June 15 in each of the years from 1942 to 1951, inclusive. The proceeds will be used as part of the purchase price of new equipment costing a total of $5,522,223 and consisting of 1,000 50-ton, all-steel hopper cars, 1,000 50-ton, steel-sheathed, wood-lined box cars, and 100 50-ton, all-steel, wood-lined, double-door box cars. Orders for this equipment were announced in the May issue.

Montour.—The Montour has asked the Interstate Commerce Commission for authority to assume liability for $500,000 of equipment trust certificates, bearing interest at not more than 2½ per cent and maturing in five equal annual installments on June 16 in each of the years from 1942 to 1946, inclusive. The proceeds will be used as a part of the purchase price of new equipment costing a total of $702,381 and consisting of 300 all-steel, 50-ton hopper cars. The order for this equipment was announced in the May issue.

Nashville, Chattanooga & St. Louis.—The N. C. & St. L. company has asked the Interstate Commerce Commission for authority to assume liability for $4,290,000 of equipment trust certificates, maturing in 10 equal annual installments of $429,000 on July 15 in each of the years from 1942 to 1951, inclusive. The proceeds will be used as part of the purchase price of new equipment costing a total of $4,766,667 and consisting of 10 4-8-4 steam locomotives; four 660-hp. Diesel-electric switching locomotives; two 1,000-hp. Diesel-electric switching locomotives; 500 steel-sheathed, wood-lined box cars of 40 tons capacity; 200 all-steel hopper coal cars of 50 tons capacity; and 300 all-steel, solid-bottom gondola cars of 50-ton capacity. The order for 200 hopper coal cars was announced in the May issue. Orders for the locomotives and other freight cars are announced elsewhere in this issue.

New York Central.—The N. Y. C. has asked the Interstate Commerce Commission for authority to assume liability for $15,000,000 of equipment trust certificates, maturing in 10 equal annual installments of $1,500,000 on July 15 in each of the years from 1942 to 1951, inclusive. The proceeds will be used as part of the purchase price of new equipment costing a total of $16,808,333 and consisting of 4,000 55-ton steel box cars; 1,000 70-ton, high side, gondola cars; 15 oil-electric switching locomotives; and fifteen L-3c Mohawk type freight locomotives. Orders for 1,000 box cars and 1,000 gondola cars were announced in the May issue and 3,000 box cars in the June issue. The locomotive orders are announced elsewhere in this issue.

New York, Chicago & St. Louis.—The Nickel Plate has asked the Interstate Commerce Commission for authority to assume liability for $1,250,000 of equipment trust certificates, bearing interest at not more than 2½ per cent and maturing in 10 equal annual installments of $125,000 on June 15 in each of the years from 1942 to 1951, inclusive. The proceeds will be used as part of the purchase price of new equipment costing a total of $1,463,275 and consisting of 18 70-ton covered hopper cars and 500 50-ton, 40 ft. 6 in., all-steel box cars. The order for the box cars was announced in the May issue and the order for the covered hopper cars in the June issue.

New York, New Haven & Hartford.—The New Haven has asked the Interstate Commerce Commission for authority to assume liability for $2,890,000 of equipment trust certificates, maturing in 10 equal annual installments of $289,000 on July 1 in each of the years from 1942 to 1951, inclusive. The proceeds will be used as part of the purchase price of new equipment costing a total of $3,618,000 and consisting of 10 100-ton Diesel-electric switching locomotives, 6 44-ton Diesel-electric switching locomotives, and 1,000 all-steel box cars. An order for six 44-ton Diesel-electric locomotives was reported in the June issue and orders for ten 660-hp. Diesel-electric locomotives and 1,000 box cars in the April issue.

New York, Susquehanna & Western.—The Susquehanna will shortly place orders for two Diesel-electric locomotives of 1,000 hp. each. This company is also seeking Federal court authority for the purchase of an additional six Diesel-electric units of 1,000-hp.

Northern Pacific.—The Northern Pacific has asked the Interstate Commerce Commission for authority to assume liability for $5,700,000 of equipment trust certificates, maturing in 10 equal annual installments on July 15 in each of the years from 1942 to 1951, inclusive. The proceeds will be used as part of the purchase price of new equipment costing a total of $6,425,000 and consisting of 1,850 steel-sheathed box cars and 200 all-steel, 70-ton selective ballast bars. Orders for this equipment are reported elsewhere in this issue.

Pennsylvania. — A contract has been awarded to the Ellington Miller Company of Chicago for the construction of an extension to the company's enginehouse at 55th street, Chicago.

Pere Marquette.—The Pere Marquette has asked the Interstate Commerce Commission for authority to assume liability for $2,775,000 of equipment trust certificates, bearing interest at not more than 2½ per cent and maturing in 15 equal annual installments of $185,000 on June 1 in each of the years from 1942 to 1956, inclusive. The proceeds will be used as part of the purchase price of new equipment costing a total of $3,513,761 and consisting of 300 50-ton, all-steel box cars; one hundred 40-ton, all-steel automobile-furniture box cars; 25 50-ton, all-steel automobile box cars; 75 50-ton, all-steel single door automobile box cars; twenty-five 70-ton, all-steel covered hopper cars; 40 30-ton, all-steel caboose cars; and twelve class N-1 freight locomotives, type 2-8-4 with 22,000 gallon tenders. Orders for this equipment were reported in the March, April, and June issues.

Southern.—A drop pit and inspection pits for Diesel locomotives, and an extension to the tank shop are being constructed by the company forces at Chattanooga, Tenn. The cost of the work will be approximately $34,500.

The Southern has asked the Interstate Commerce Commission for authority to assume liability for $11,250,000 of equip-

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ment trust certificates, maturing in 10 equal annual installments of $1,125,000 on July 1 in each of the years from 1942 to 1951, inclusive. The proceeds will be used as part of the purchase price of new equipment costing a total of $12,517,000 and consisting of three thousand four hundred box cars, five hundred flat cars, one hundred gondola cars, five Diesel-electric switch engines, and 25 baggage-express cars. Orders for the freight-car equipment and the baggage-express cars were announced in the June issue.

Southern Pacific.—The Southern Pacific has asked the Interstate Commerce Commission for authority to assume liability for $14,625,000 of 2¼ per cent equipment trust certificates, maturing in 15 equal annual installments of $975,000 on June 1 in each of the years from 1942 to 1956, inclusive. The proceeds will be used as part of the purchase price of new equipment costing a total of $18,281,250 and consisting of 40 4-8-8-2, Class AC-10, oil-burning locomotives with 22,000-gal. rectangular tenders; 10 4-8-4 semi-streamlined oil-burning locomotives with 23,500-gal. rectangular tenders; 2,500 steel-sheathed, wood-lined box cars, and 50 tight-bottom gondola cars. Orders for this equipment were announced in the April and May issues.

The purchase of an additional number of steam locomotives of the 4-8-8-2 type is being considered by the road.

Wabash.—The Wabash has been authorized by the district court to purchase two 660-hp. Diesel-electric switching locomotives at a cost of $120,000 and 25 hopper cars at a cost of $98,000, and to build in its own shops 1,000 box cars at a cost of $3,388,000.

Supply Trade Notes

Norman L. Deuble, formerly assistant to the vice-president of the Copperweld Steel Company, Warren, Ohio, has been appointed manager of sales.

◆

Alva E. Radcliffe, sales representative of Thomas A. Edison, Inc., with headquarters at Chicago, has been promoted to Cleveland district manager, to succeed Peter R. Nelson, deceased.

◆

A. F. Dohn, vice-president in charge of tool steel sales of the Allegheny Ludlum Steel Corporation, has retired from active service and will continue with the company in a consulting capacity as a vice-president.

◆

C. A. Brown, formerly of the Washington, D. C. office of the American Locomotive Company, has been appointed district sales manager with headquarters in the Red Rock Building, 187 Spring St., N. W., Atlanta, Ga.

◆

National Tube Company.—*C. R. Cox* has been elected executive vice-president of the National Tube Company, a subsidiary of the United States Steel Corporation, succeeding *B. C. Moise*, who has retired after more than 50 years continuous service. *Elmer N. Sanders*, formerly assistant vice-president, operations, has been elected vice-president in charge of operations to succeed Mr. Cox.

◆

Samuel F. Pryor, Jr., has severed his connection with the American Brake Shoe & Foundry Company, and the Southern Wheel division of that company and has been elected vice-president and assistant to the president of the Pan-American Airways Corporation. Mr. Pryor had been associated with the American Brake Shoe & Foundry Company for 17 years.

◆

E. C. Gunther, formerly a buyer in the purchasing department of the Chicago, Burlington & Quincy, has been appointed district manager, midwest territory, of the Duff-Norton Manufacturing Company, with headquarters at Chicago, to succeed Alex S. Anderson, deceased. Mr. Gunther was born in Chicago on February 5, 1889. He entered the employ of the Chicago, Burlington & Quincy in 1916 and since has held the positions of bookkeeper, tracing clerk, scrap clerk and buyer in the purchasing department.

◆

George I. Wright, who has heretofore represented the Coppus Locomotive Equipment Company, Worcester, Mass., among Eastern railroads, has been appointed to represent the Coppus company on railroads having general offices in the states of Ohio, Indiana, Illinois, Michigan, Wisconsin, Nebraska, Iowa, and Minnesota. Mr. Wright was formerly with the Reading, Illinois Central and Southern Pacific railroads.

◆

The George C. Lever Company has been appointed Lo-Head Electric Hoist representative for the American Engineering Company in the Northern New Jersey, Greater New York and Long Island territory. George J. Sturmfelsz will represent the company in the State of Delaware; H. E. Mensch in the Detroit, Mich. territory and the American Steel Export Company of New York in certain foreign markets.

◆

J. Arthur Deakin has been appointed Eastern District Manager for McKenna Metals Company, Latrobe, Pa., manufacturers of Kennametal steel-cutting carbide tools and blanks. Mr. Deakin will be in charge of the new Eastern sales office of McKenna Metals at 50 Church St., New York City, and will serve the New England States and northern New Jersey.

J. A. Deakin

Mr. Deakin has been engaged continuously in the carbide tool business since its inception in this country in 1928, and for many years previous was active in the machine tool field. He was appointed Eastern representative by McKenna Metals Company when Kennametal was introduced in 1938.

◆

Manning, Maxwell & Moore, Inc.—William D. McCarley has been appointed Pacific Coast representative of the locomotive equipment division of Manning, Maxwell & Moore, Inc., with headquarters in San Francisco. He replaces Newton B. Selover, who has been transferred to the Chicago district. Mr. McCarley had been chief electrician of the Eastern division of the Western Pacific for the past five years and prior thereto was with the Denver & Rio Grande Western shops.

Obituary

Dudley Brewster Bullard, vice-president of the Bullard Company of Bridgeport, Conn., died June 10 after a long illness.

◆

Robert L. Cairncross, district sales manager of the National Lock Washer Company, Newark, N. J., with headquarters at Chicago, died in Tucson, Ariz., on June 13.

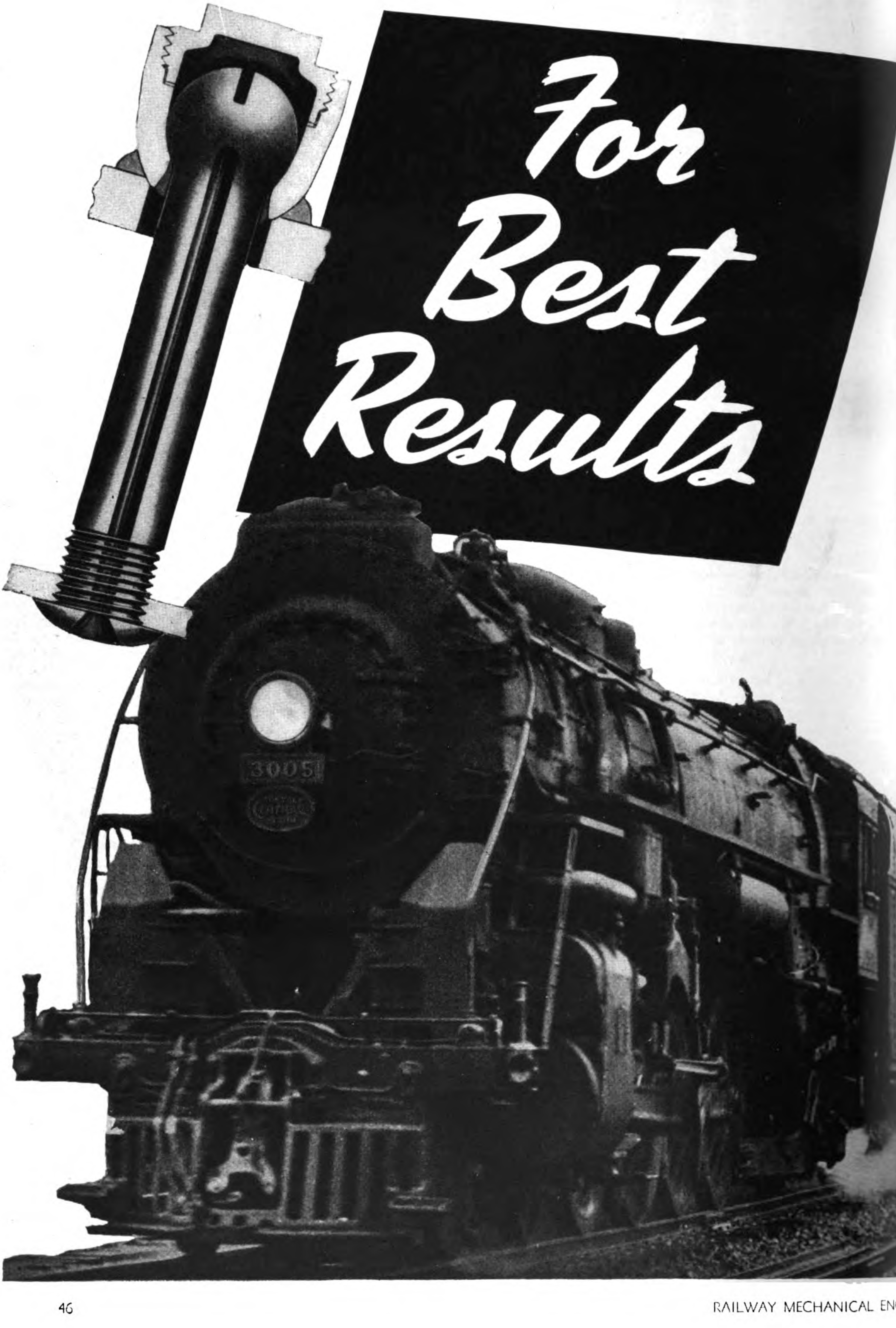
◆

Charles B. Jahnke, president and general manager of The Cooper-Bessemer Corporation, died of a heart attack at Mercy Hospital in Mount Vernon, Ohio, May 6. He was 52 years old.

◆

Charles E. Miller, a representative in Chicago of the Universal Locomotive Arch Company, died suddenly of heart failure in that city on June 8. Mr. Miller has been with the Universal Locomotive Arch Company for 20 years and previously served with the American Arch Co., Inc., and the Chicago & North Western.

(*Turn to second left-hand page*)


For
Best
Results
3005

TO INSURE
MAXIMUM SAFETY.....
MAXIMUM ECONOMY...
MAXIMUM AVAILABILITY

Personal Mention

General

Pedro C. Morales has been appointed general superintendent of motive power and machinery of the National Railways of Mexico, with headquarters at Mexico City, D. F.

Frederick T. H. James, master mechanic of the Morris and Essex division of the Delaware, Lackawanna & Western, with headquarters at Hoboken, N. J., has been appointed assistant to chief of motive power, with headquarters at Scranton, Pa. Mr. James was born on March 16, 1894, at

Frederick T. H. James

Buffalo, N. Y. He attended the public schools and studied machine shop practice at the Y. M. C. A., Buffalo. Following a business college course, he entered civil service. From 1906 to 1909 he served an apprenticeship and in September, 1909, became an enginehouse utility worker on the Lackawanna at East Buffalo. For some months in 1911, Mr. James was assigned to the master mechanic's office in connection with the compilation of special locomotive performance reports, later being promoted to coal-chute foreman at the East Buffalo enginehouse, and then acting as a machinist at the East Buffalo locomotive shop. He became general foreman at Groveland, N. Y., in October, 1915, and erecting shop foreman at East Buffalo in February, 1918. He then served in various positions until February, 1923, when he was assigned to the Buffalo division as special locomotive and boiler inspector. On November 1, 1923, he was transferred to Binghamton, N. Y., as day enginehouse foreman and on February 18, 1924, was promoted to general foreman at the Kingsland N. J., locomotive shop. Mr. James became master mechanic of the Morris and Essex division in May, 1939.

B. V. Johnson, assistant master mechanic on the Los Angeles division of the Union Pacific, has been appointed maintenance supervisor—Diesel motive power, a newly created position, with headquarters at Omaha, Neb. Mr. Johnson will have general supervision over the maintenance of Diesel switching locomotives at Omaha.

Pedro Angelini has been appointed assistant general superintendent of motive power and machinery of the National Railways of Mexico, with headquarters at Mexico City, D. F.

Master Mechanics and Road Foremen

C. F. Deno, division master mechanic on the Canadian Pacific at Winnipeg, Man., has been appointed master mechanic of the Manitoba district, with the same headquarters, succeeding W. J. Renix, who retired on May 31.

G. C. Bogart has been appointed assistant master mechanic of the Southern Pacific Company (Pacific Lines), Shasta district, Sacramento Division, with headquarters at Dunsmuir, Calif.

Arthur H. Fiedler, who has been appointed general master mechanic, Eastern district (Lines east of Livingston, Mont.), of the Northern Pacific, with headquarters at St. Paul, Minn., as announced in the May issue, was born on January 24, 1884,

A. H. Fiedler

at Fargo, Mont. He attended high school at Butte, Mont., graduating in 1902. On June 3, 1903, he became storeroom clerk on the Northern Pacific. From September, 1904, until September, 1907, he was a locomotive fireman. From the latter date until May, 1934, he served as a locomotive engineer, becoming road foreman of engines in May, 1934, and master mechanic in February, 1939, which position he held at the time of his recent appointment.

Car Department

L. E. Hilsabeck, general car inspector of the Chicago Great Western, who has been appointed to fill the newly created position of assistant superintendent of the car department, with headquarters as before at Oelwein, Iowa, as noted in the April issue, was born on November 4, 1897, at Marshalltown, Iowa. In 1915, he was graduated from high school at Seattle, Wash., and during the next year attended Oberlin College. During the summer vacation of 1915 he served as a car repair helper on the Chicago Great Western. In April, 1917, he enlisted in the U. S. Navy, and on September 19, 1919, returned to the Oelwein shops of the Chicago Great West-

L. E. Hilsabeck

ern and served successively as A. R. A. clerk, piecework inspector, and contract shop inspector of new equipment. In January, 1930, he was appointed inspector foreman at the Oelwein freight and passenger terminal and in July, 1931, became car foreman, Oelwein Terminal. Mr. Hilsabeck was appointed general car inspector in charge of freight and passenger cars in April, 1936.

James Purcell, foreman of the car department of the Morris and Essex division of the Delaware, Lackawanna & Western, has been appointed master mechanic of the

J. Purcell

division, with headquarters at Hoboken, N. J. Mr. Purcell was born on July 18, 1896, in Passaic, N. J. He attended both the public and high schools of Passaic, entering the employ of the D. L. & W. on May 2, 1913, as a machinist apprentice at Kingsland, N. J., where he later became a machinist. He entered the service of the U. S. Army in 1917 and in 1919, after 22

(*Turn to third left-hand page*)

SIX MEN

MOVE 679,768 POUND LOCOMOTIVE EQUIPPED WITH TIMKEN BEARINGS

Tapered Roller
TIMKEN BEARING
EQUIPPED

Freight locomotive No. 2540 of the Illinois Central System recently had its driving axle, engine truck and trailer friction bearings replaced with TIMKEN Bearings at the railroad's Paducah shops.

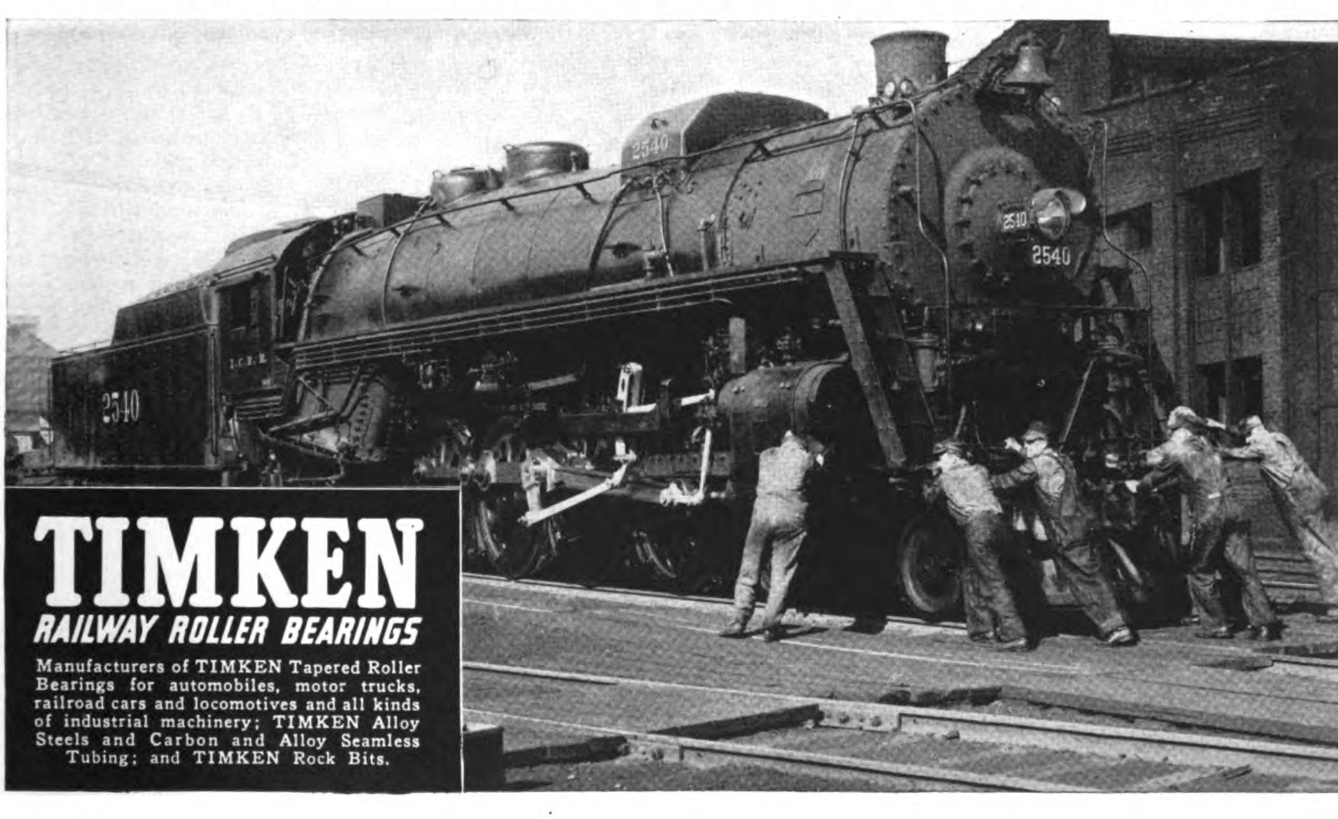
After this anti-friction treatment 6 men were able to roll the engine and tender—in working order—along a level piece of track with comparative ease.

It's a foregone conclusion that No. 2540 will be able to haul heavier loads, will possess greater availability for service, use less fuel and cost much less for maintenance now it is equipped with roller bearings.

The locomotive has been assigned to the Illinois Central's crack freighter MS-1 operating overnight between Chicago and Memphis.

Put your new and existing motive power on TIMKEN Bearings and enjoy the benefits of anti-frictionization.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO



TIMKEN

RAILWAY ROLLER BEARINGS

Manufacturers of TIMKEN Tapered Roller Bearings for automobiles, motor trucks, railroad cars and locomotives and all kinds of industrial machinery; TIMKEN Alloy Steels and Carbon and Alloy Seamless Tubing; and TIMKEN Rock Bits.

months in France, returned to the D. L. & W. as a machinist at the Hoboken enginehouse. He became a supervisor in 1923; in 1930 supervisor, electrical repair and maintenance shop, electrified suburban territory, and in 1939 foreman, car department, Morris & Essex division.

C. W. Graham, car shop superintendent of the Wabash, who has been appointed assistant superintendent of the car department, with headquarters as before at Decatur, Ill., as announced in the May issue, was born at Athens, Ohio, on September 16, 1884, and entered railway service in January, 1907, as a switchman on the Hocking Valley (now part of the Chesapeake & Ohio) at Nelsonville, Ohio. In 1908 he entered the employ of the Michigan Central as a car repairer and was later promoted to general car foreman at Saginaw, Mich. In July, 1910, Mr. Graham went to Saginaw, Mich., as chief car inspector of the Pere Marquette and a year later became general freight-car foreman of the Missouri-Kansas-Texas at Sedalia, Mo. He returned to the Pere Marquette in August, 1915, as division general car foreman at St. Thomas, Ont., and in March, 1916, went to Muskogee, Okla., as master car builder of the Kansas, Oklahoma & Gulf. In September, 1920, he went with the Wabash as general car foreman at St. Louis, Mo., and later served as division general car foreman at Moberly, Mo., and Ft. Wayne, Ind. In the latter part of 1933, Mr. Graham was appointed car-shop superintendent, with headquarters at Decatur.


Charles Wesley Graham

O. A. Wallace has been appointed superintendent of the car department of the Atlantic Coast Line, with headquarters at Wilmington, N. C.

Shop and Enginehouse

G. Lamberg, shop superintendent of the Chicago, Milwaukee, St. Paul & Pacific, at Minneapolis, Minn., has retired.

C. L. Sparks has been appointed general foreman of the Southern Pacific Company (Pacific Lines), Shasta district, with headquarters at Dunsmuir, Calif.

S. C. Selby has been appointed day enginehouse foreman of the Southern Pacific Company (Pacific Lines), with headquarters at Klamath Falls, Ore.

F. A. Longo has been appointed general boiler inspector on the Southern Pacific, with headquarters at San Francisco, Calif.

I. W. Martin, general foreman locomotive shops of the New York Central, west of Buffalo, at Collinwood, Ohio, has been appointed superintendent of shop with headquarters at West Albany, N. Y., locomotive shop.

Henry M. Sherrard, who has been appointed superintendent of shops on the Baltimore & Ohio, with headquarters at Glenwood, Pa., as noted in the June issue of the *Railway Mechanical Engineer*, was born on April 28, 1888. He attended grade and high schools and entered railroad service on March 3, 1903, as a messenger in the office of the superintendent of motive power of the B. & O. In April of the same year, Mr. Sherrard became a machinist apprentice. From 1907 to 1915, he was a machinist at Newark, Ohio. He was piecework inspector at Newark for a period of one year, and in 1916 became assistant machine shop foreman. In 1918, he became machine shop and general foreman and in 1925 was transferred to Glenwood (Pittsburgh), Pa., as general machine shop foreman. In May, 1930, he became motive-power inspector of the Western Lines and on December 21, 1937, was appointed master mechanic at Grafton, W. Va., which position he held at the time of his recent appointment.


H. M. Sherrard

Obituary

Paul H. Mitchell, superintendent of the car department of the Delaware, Lackawanna & Western, with headquarters at Scranton, Pa., died suddenly on June 14, at the age of 52. Mr. Mitchell was born on February 23, 1889, at Prescott, Ark., and entered railroad service on June 1, 1907, in the car department of the St. Louis-San Francisco, where he served until June, 1908. From August 1, 1908, to July 1, 1910, he was car repairer on the Prescott & North Western. He became car inspector on August 1, 1910, on the Memphis, Dallas & Gulf at Nashville, Ark., on January 1, 1912, was appointed inspector on the latter road and was subsequently promoted to general inspector. On August 7, 1916, he became air-brake inspector and Baker heater man with the San Antonio, Uvalde & Gulf. He became general foreman and master car builder on the Memphis, Dallas & Gulf on February 4, 1917, and four years later entered the employ of the Texas & Pacific as general car inspector. Mr. Mitchell entered the service of the Lackawanna on April 4, 1936, as general car inspector and two years later was appointed master car builder. On October 16, 1939, he became superintendent of the car department.

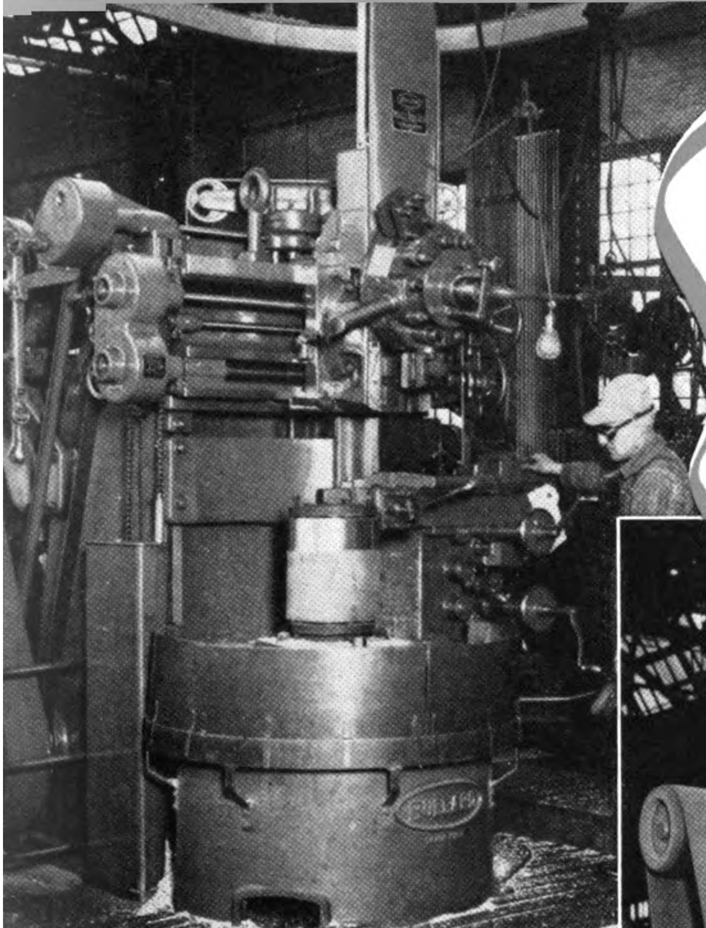

P. H. Mitchell

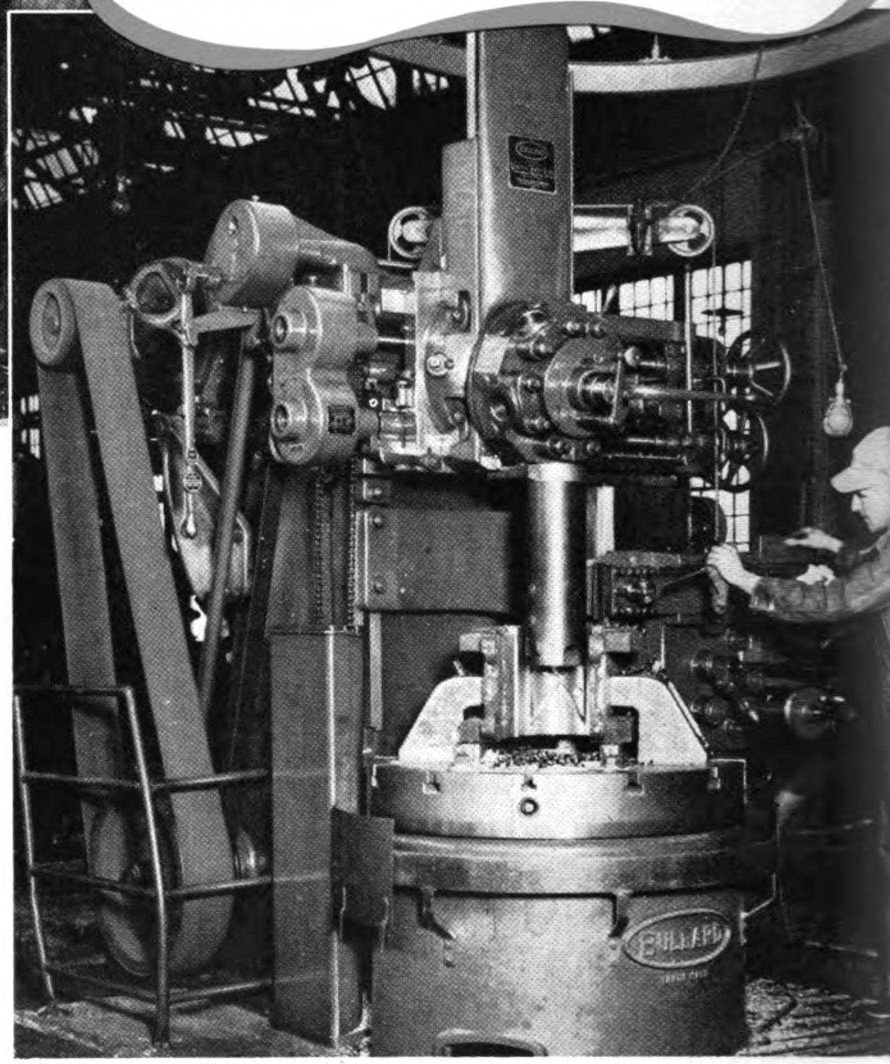
John Erhardt Muhlfeld, consulting engineer and leader in the development and design of motive power and rolling stock, died on June 19 at Harkness Pavilion, New York, of a heart attack, after an illness of two weeks, at the age of 68. Mr. Muhlfeld was born at Peru, Ind., on September 18, 1872, and entered railroad service during the summer of 1890. After serving in various capacities on the Wabash and its predecessors, and with Canadian roads, he entered the service of the Baltimore & Ohio in 1902, serving successively as assistant to general superintendent motive power, superintendent motive power and general superintendent motive power. From 1910 to 1912 Mr. Muhlfeld was vice-president and general manager in charge of reconstruction, Kansas City Southern, at Kansas City, Mo. During 1912 and 1913 he investigated steam railway practices in European countries, and since the latter year has been a consulting engineer, with offices at New York. Mr. Muhlfeld was the author of many papers on various phases of railway operation and management published in railway, scientific and technical journals. His principal activities included railway improvement, rehabilitation, valuation and development of railway motive power, rolling stock, shop machinery, tool and power-plant equipment, etc. During the first World War he developed the use of powdered coal as substitute for fuel oil in marine service.

Railway Mechanical Engineer

August 1941

FOUNDED IN 1832





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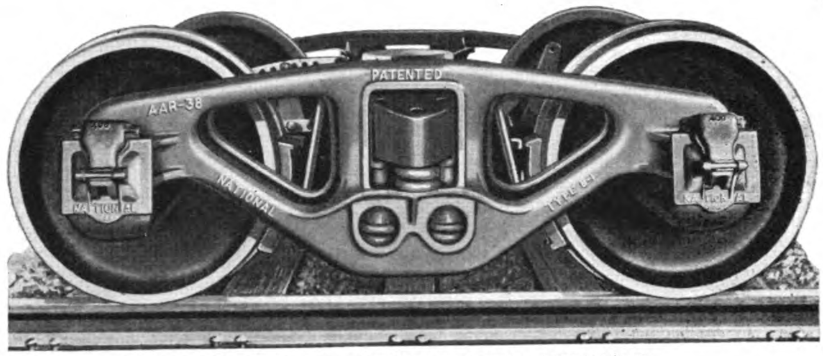
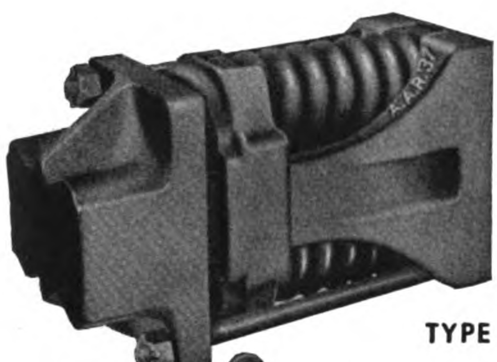
NATIONAL PRODUCTS

Reduce Operating Costs



NATIONAL B-1 STABILIZED TRUCK.

A. A. R. Approved Draft Gears



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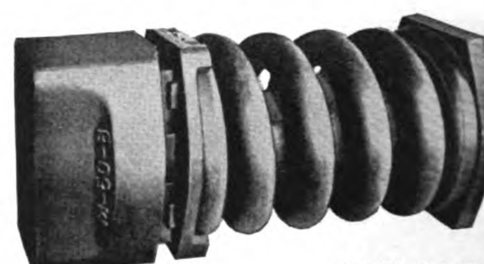

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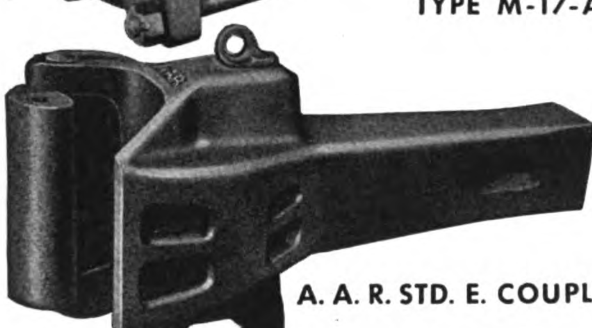
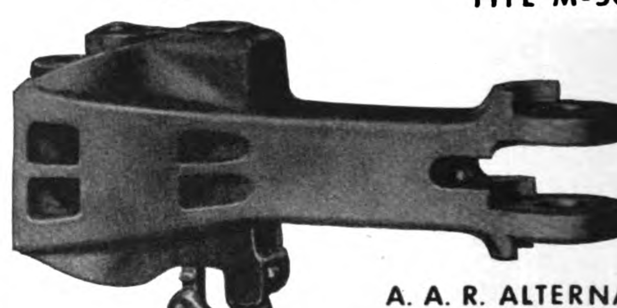


A. A. R. STD. E. COUPLER



A. A. R. ALTERNATE STD. E. COUPLER

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A. A. R. ALTERNATE STD. VERTICAL PLANE SWIVEL YOKE

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RAILWAY
MECHANICAL ENGINEER

Research and Design of Modern

Steam Passenger Locomotives*

Part I

By P. W. Kiefer†

The development of passenger locomotives on the New York Central showing the methods used to satisfy the continued demands for increased power

In recent years, much valuable information and data on the modern steam locomotive, its elements and adjuncts, have been published or otherwise made available by many eminent engineers interested in railroad motive power. As a result of these painstaking efforts, the subject as a whole and the factors into which it subdivides have been particularly well covered. Nevertheless, when dealing with the subject of motive power from the standpoint of meeting the constantly changing needs of the modern railroad, even over a relatively short period of time, it soon becomes evident that the problems to be faced and solved are both complex and numerous and usually urgent.

With these circumstances indicated, it will be the author's main purpose to review the practical aspects of the problems which have been involved in supplying high-capacity steam motive power for fast and heavy service on the New York Central during the last 15 years; to recite the several design and performance objectives, as determined in advance for this motive power; to submit information indicating the extent to which these objectives have been attained, as checked through performance tests under regular passenger-train operating conditions; and, finally, to express some thoughts on trends for the near future in design improvement.

While many of the problems confronted are similar to those encountered on other large railroads and the solutions in a number of respects are alike, it is desired to discuss specific matters which can be directly handled and to avoid the use of generalities so far as practicable. For these reasons, the content of this paper has been confined to the motive power of the New York Central.

It is not the intention to detail the features of the motive-power units here included but instead to limit the descriptive matter to major characteristics of design, supplemented in some instances by reference to special equipment items and to avoid, as far as practicable, repetition of what is already well known or is readily procurable from various sources.

Historical Background

In 1904, when the Consolidation, Ten-Wheeler, Atlantic, and Prairie types were still the conventional freight and passenger locomotives in common use for heavy duty on the New York Central, the first of a series of Pacific type locomotives, Class K-80, was introduced on the Michigan Central. During the following year, passenger locomotives of the same type were placed in service on the Boston & Albany and on the Cleveland, Cincinnati, Chicago & St. Louis. In 1907, the New York Central and the Lake Shore and Michigan Southern, now New York Central Lines West, received modifications of this type in the form of somewhat larger locomotives, designated as Class K-2.

These engines successfully handled the work assigned to them and succeeding lots of the same type were installed until 1911, when a somewhat heavier and more powerful Pacific type was produced. This design is known as the Class K-3, a considerable number of which are still in active service.

Continuing Demand for Increased Power

Shortly after the introduction of the last of the K-3 class, it became evident that a further substantial increase in power was required and an attempt was made to meet this demand by a yet larger Pacific, having 25-in. by 28-in. cylinders instead of 23½-in. by 26-in., and with firebox and boiler capacity increased proportionately. With 79-in. driving wheels and a working boiler pressure of 200 lb. per sq. in., these locomotives developed a rated tractive force of 37,650 lb. which, by the use of a booster, was increased to 47,350 lb. This design was designated as Class K-5, and, in view of its increased size, hand firing was no longer practicable for capacity operation, so mechanical stokers were installed.

The progressive development of the Pacific type from the original Class K-80 on the Michigan Central, built in 1904, to the latest Class K-5, built in 1926, is shown in Table I, the principal characteristics of each typical design being indicated. Fig. 1 shows the drawbar pull and drawbar horsepower versus speed for each of these distinct designs, the curves being typical of actual performance on the road under regular operation with locomotives in good condition.

The K-5 class, built in 1925 and 1926, was supplied with a tender carrying 15,000 gallons of water on six-wheel trucks, which marked the introduction of the large-capacity tender for New York Central passenger

* Paper contributed by the Railroad Division and presented at the semi-annual meeting of The American Society of Mechanical Engineers at Kansas City, Mo., on June 17, 1941. This paper will be published in two parts.

† Chief engineer, motive power and rolling stock, New York Central.

Table I—Progressive Development of the New York Central Pacific- and Hudson-Type Locomotives

Class	K-80	K-2a	K-3q	K-3r	K-5b	J-1e	J-3a
Type	4-6-2	4-6-2	4-6-2	4-6-2	4-6-2	4-6-4	4-6-4
Year built	1904	1907	1923	1925	1926	1931	1937
Cylinders, number, diameter and stroke, in.	2—22 x 26	2—22 x 28	2—23½ x 26	2—24 x 26	2—25 x 28	2—25 x 28	2—22½ x 29
Wheels, diameter outside tires, in.:							
Driving	75	79	79	79	79	79	79
Max. tractive force, engine, lb.	28,500	29,160	30,900	32,200	37,650	42,360	43,440
Max. tractive force, booster, lb.	......	......	9,700	9,700	9,700	10,900	12,100
Weights in working order, lb.:							
On drivers	142,500	173,000	194,500	169,000	185,000	190,700	201,500
Total engine	224,000	268,000	295,500	278,000	302,000	358,600	385,100
Tender:							
Water capacity, gal.	6,000	7,500	8,000	10,900	15,000	15,000	14,000
Fuel capacity, tons	14	12	12	16½	16	24	30
Trucks	4-wheel	4-wheel	4-wheel	4-wheel	6-wheel	6-wheel	6-wheel
Boiler:							
Steam pressure, lb. per sq. in.	200	200	200	200	200	225	275
Diameter, first ring, inside, in.	70⅝	70⅝	70⅝	70⅝	79½	82⁷/₁₆	80⅝
Diameter, largest outside, in.	75¹/₁₆	83	83	83	84	87⅝	91½
Grate area, sq. ft.	50.2	56.5	56.5	56.7	67.8	81.5	82.0
Heating surfaces, sq. ft.:							
Evaporative	3,283	3,789	3,424	3,421	3,952	4,484	4,187
Superheating	672	724	832	839	1,150	1,951	1,745
Comb. evap. and superheat.	3,955	4,513	4,256	4,260	5,102	6,435	5,932
Wheel bases, ft.-in.:							
Driving	13—0	14—0	14—0	13—8	13—8	14—0	14—0
Engine, total	33—7½	36—6	36—6	36—5	36—11	40—4	40—4
Horsepower:							
Max. indicated	1,700 at 39 m.p.h.	2,000 at 45 m.p.h.	2,100 at 45 m.p.h.	2,140 at 45 m.p.h.	3,200 at 54 m.p.h.	3,900 at 67 m.p.h.	4,725 at 75 m.p.h.
Max. drawbar	1,430 at 35 m.p.h.	1,655 at 40 m.p.h.	1,720 at 40 m.p.h.	1,750 at 40 m.p.h.	2,530 at 45 m.p.h.	3,240 at 58 m.p.h.	3,880 at 65 m.p.h.

operation, the progressive elimination of service stops, and the extension of locomotive runs.

A survey undertaken in 1926 of the facts and conditions as related to the necessity for a further increase in the power of mainline passenger locomotives, together with consideration of probable future needs, led quickly to the definite conclusion that a unit of an entirely new design and type must be developed.

A New Type Locomotive

The basic problem presented was to create a design of locomotive having the following characteristics, as compared with the Pacific types heretofore used: (1) Somewhat greater starting tractive force with increased horsepower capacity and maximum output at much higher speed; (2) boiler of ample sustained capacity to satisfy the cylinder requirements for maximum power development, under severe weather and other conditions; (3) weight distribution, wheel loads, and counterbalance to be such that impact forces and rail stresses could be confined to lower limits than heretofore observed, thus contributing to higher standards of track maintenance and obtaining better train riding characteristics; (4) increased thermal efficiency; (5) clearances to permit operation without restriction; (6) symmetrical appearance with smooth lines, free from the effects of miscellaneous appliances, piping, and other details and, (7) a high degree of reliability for uninterrupted service under conditions of dense traffic, especially on the eastern section, requiring relatively simple but adequate machinery, combined with the use of well proved auxiliary equipment, such as feedwater heaters and mechanical stokers.

After the preparation of several preliminary designs, in which the American Locomotive Company, the Superheater Company, and others cooperated to the fullest extent, the conclusion was reached that the objectives could be most efficiently attained by using a 4-6-4 wheel arrangement which would satisfy the requirements for capacity and weight and avoid the addition of a fourth pair of driving wheels, with a resultant increase in size, weight, and first cost, as well as higher maintenance costs.

This arrangement represented the first locomotive having six driving wheels built with four-wheel leading and trailing trucks for service in America.

To meet the demand for exceptional steaming capacity at sustained high speed with heavy load, the size and proportions of the boiler were given first consideration, ample heating surfaces being essential, with extra-large superheater and a grate area sufficient to insure an economical rate of firing under maximum conditions of steam generation. To carry the added weight thus imposed on the rear of the locomotive, without excessive loads on trailing or coupled axles, the four-wheel trailing truck was used, thus securing the advantage of providing for large firebox capacity with comparatively light individual axle loads and consequent low rail stresses. The boiler as finally designed had the following general dimensions and proportions:

Boiler:	
Firebox, length, in.	130
Firebox, width, in.	90¼
Volume of firebox, cu. ft.	428
Diameter of boiler at smokebox, in.	82⁷/₁₆
Diameter of boiler at back tube sheet, in.	87⅝
Tubes, number and diameter, in.	201-3½
Flues, number and diameter, in.	37-2¼
Length over tube sheets, ft.-in.	20-6
Net gas area through tubes and flues, sq. ft.	9.67
Grate area, sq. ft.	81.50
Heating surfaces, sq. ft.:	
Tubes and flues	4,203
Firebox	281
Evaporative, Total	4,484
Superheating (Type E)	1,951
Comb. evap. and Superheat.	6,435

In developing the boiler design, the provision of a combustion chamber was carefully considered but, because of serious difficulties then being experienced with riveted-seam construction, it was finally omitted.

To reduce the pressure drop and other losses and to provide for more efficient use of the steam in the cylinders, the steam and exhaust passages were enlarged, as compared with the K-5 Pacific type, and a front-end throttle was installed. A large-volume steam chest with 14-in. valves, similar to those of the K-5 class, was retained.

Other special features included air compressors mounted on the front deck for improved weight distribution and, for the first time, a specially designed cast-steel pilot and drop coupler, providing a surface free from the projection of coupler and pocket for

clearing effectively possible obstructions on the right of way. The centrifugal-type boiler feed pump was first introduced on this design with the heater located in a recessed portion of the smokebox top and a large portion of the piping placed under the jacket. Careful attention was given to the arrangement of controls and gages in the cab for convenient access and clear vision.

Table I also shows the principal dimensions and weights for the Class J-1e which are the same as those finally determined for the first sample J-1a, No. 5200,* built in 1927, except that the weight on drivers was 182,000 lb. and total engine weight was 343,000 lb. A tender with four-wheel trucks was used with this first engine having a capacity of 10,000 gallons of water and 18 tons of coal.

From 1927 to 1931, a total of 205 of these locomotives, designated as the Hudson type, were received and placed in service.

Subsequently, all of the J-1 class were dynamically counterbalanced to provide smoother operation and to permit the use of shorter running cut-off, as well as to improve the track effects. Roller bearings were installed

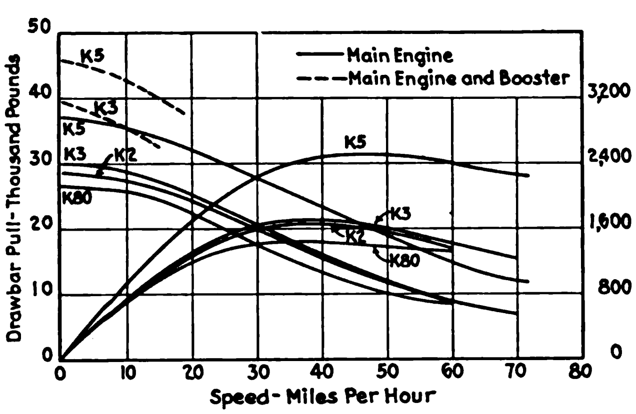


Fig. 1—Drawbar pull and horsepower vs. speed—Class K locomotives

on all engine and tender trucks and to the driving wheels of eight locomotives. All engines received speed recorders, later augmented by cut-off selection equipment.

Cast-steel beds with integral cylinders were applied, the engines already being equipped with one-piece cast-steel tender frames, engine-truck, trailer-truck, and tender-truck frames. The substitution of integral construction for the multiple-bolted parts of earlier locomotives eliminated a large number of bolts and contributed to increased availability and continuity of operation with substantial reduction in maintenance costs.

At the end of 1940, a total of 437 locomotives of this 4-6-4 type had been placed in service in the United States and Canada, including the 275 on the New York Central. The total weight in working order for each of these locomotives ranged from 310,000 to 415,000 lb. with corresponding variations in maximum tractive force.

Performance and Capacity Tests, J-1 Hudson Type Versus K-5 Pacific Type

Class J-1a No. 5200 was subjected to complete performance and capacity tests† shortly after delivery in 1927. Because of the total engine weight being held to 343,000 lb. and the smaller and lighter tender used, this locomotive delivered a maximum drawbar horsepower of 3,300 at 58 m.p.h. However, subsequent improvements already referred to increased the weight of the Hudson-type locomotives and, consequently, the principal test results here given are for the last-built and heavier class J-1e tested in 1937.

The complete performance and capacity tests of Classes J-1e (No. 5339) and K-5b (No. 8363) were conducted under spring and summer weather conditions over the Mohawk Division of the New York Central between Albany and Syracuse, a distance of 140 miles. This division is generally representative in profile and operating characteristics of the main line between New York and Chicago with the exception of the severe though comparatively short grade westbound between Albany and West Albany, a distance of about 3 miles, where the maximum grade is 1.63 per cent on a curvature of 3½ deg. With a total rise westbound of 384 ft. in the 140-mile division over a rolling profile, the average grade is 0.05 per cent with a maximum of about 0.5 per cent for approximately 1.5 miles westbound and about 0.75 per cent for slightly over 2 miles eastbound.

All tests were made under service conditions of operation, the trains consisting of empty standard steel passenger coaches varying in number from 10 to 20 which, with a dynamometer car, provided train weights of 780 to 1,465 tons. These trains were selected as representative of normal daily operation expected of the locomotive. Average test results demonstrated that the class J-1 Hudson type surpassed all previous New York Central locomotives in maximum horsepower, coal and water consumption per horsepower, weight per horsepower, and over-all efficiency.

A comparison of the principal results obtained for a single division run with representative trains is given in Table II. It should be especially noted that, except for the maximum power characteristics which may be duplicated at will with full boiler pressure and locomotive in good condition, the results shown are on the basis of over-all averages for the complete division runs, and indicate regular daily service performance rather than maximum values for short periods or under controlled conditions for the separate items.

Table II—Comparison of Test Run for K-5 and J-1 Locomotives

	Maximum output		Improvement,
	K-5	J-1	J-1, per cent
Tractive force with booster, lb.	48,750	55,100	13.0
Main engine tractive force, lb...	40,000	45,400	13.5
Main engine drawbar pull, lb...	37,000	41,300	11.6
Cylinder horsepower	3,200	3,900	22.0
	at 54 m.p.h.	at 67 m.p.h.	24.1
Drawbar horsepower	2,530	3,240	28.1
	at 45 m.p.h.	at 58 m.p.h.	28.9
Average-performance Data			
Number of cars and weight in tons	15—1,053	18—1,244	...
Average working speed, m.p.h...	51.2	55	...
Average firing rate, lb. dry coal per hr.	5,867	6,940	...
Water delivered to boiler, lb. per hr.	40,636	57,200	...
Evaporation per lb. of dry coal, lb.	6.94	8.24	18.7
Combined efficiency — boiler, feedwater heater and superheater, per cent	67.8	74.6	10.0
Steam per indicated horsepower-hour, lb.:			
Cylinders only	15.42	15.44	...
Including auxiliaries	17.00	17.28	...
Dry coal per indicated horsepower-hour, lb.:			
Cylinders only	2.22	1.94	12.6
Including auxiliaries	2.46	2.10	14.6
Coal as fired per car mile, lb...	7.22	7.03	2.6
Weight per indicated horsepower, lb.	94	90	4.3
Based on working-order weight, lb.	302,000	352,000	...

* "Hudson Type Locomotive on N. Y. C.," *Railway Mechanical Engineer*, March, 1927, pp. 139-141.
† A summary of these tests appeared on page 1420D13, June 20, 1928, issue of the Railway Age June Dailies.

Comparative curves representing the drawbar pull and drawbar horsepower versus speed are shown in Fig. 2, which also includes curves for locomotives of more recent design as discussed later. With a starting effort approximately 12 per cent greater than the K-5, increasing to 37 per cent more at a speed of 70 m. p. h., and with an increase of 28 per cent in maximum drawbar horsepower at a speed 29 per cent higher, the weight per horsepower of the J-1 Hudson type has been decreased.

The Improved Hudson Type, Class J-3

As early as 1931, when the last of the J-1 class was built, consideration was already being given to the future development of this type in anticipation of greater power demand necessitated by the constantly increasing weight of trains and shortening of schedules. In order to reduce weight and also to gain some experience in the use of alloy steel of high tensile strength, with a view toward increasing the steam pressure, three of these locomotives were equipped with nickel-steel boilers. Two of the three also had roller bearings on all wheels except on the trailing truck, and the entire lot had roller bearings on the engine truck and tender wheels.

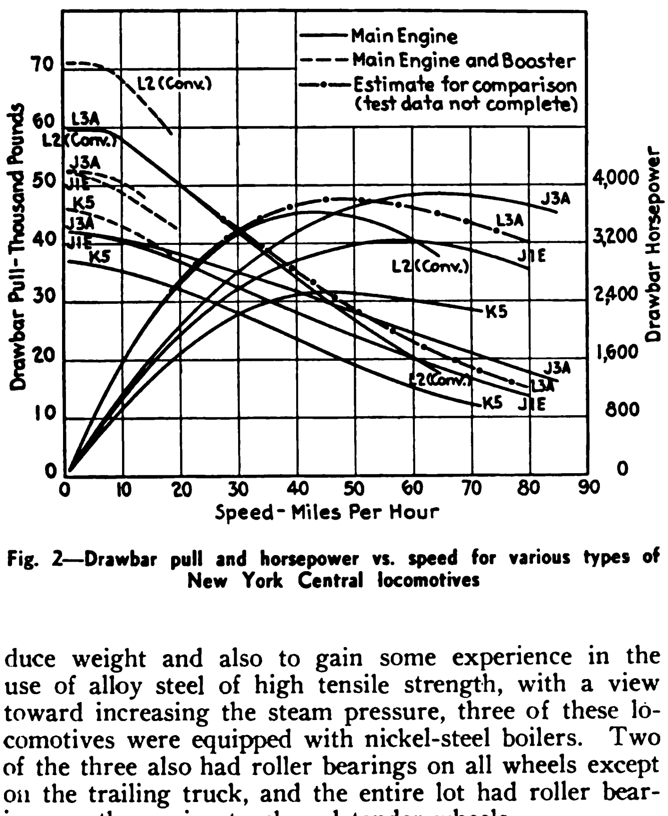


Fig. 2—Drawbar pull and horsepower vs. speed for various types of New York Central locomotives

Subsequently, one of the three, No. 5344, received lightweight roller-bearing rotating and reciprocating parts and the counter-balance was reduced proportionately, providing lower rail stresses and improved riding qualities. At this time, the boiler pressure was raised from 225 to 250 lb. per sq. in. and the cylinders were bushed to preserve the same starting tractive force and adhesion factor as on others of the same class.

As previously explained, successive lots of the J-1 class has received various improvements when built and subsequently with gradual increase in the weight of engine and tender. The weights of the original class J-1a and the latest class J-1e compare as follows:

	Original J-1a	Latest J-1e
On engine truck, lb.	63,500	65,700
On drivers, lb.	182,000	190,700
On four-wheel trailing truck, lb.	97,500	102,200
Total engine, working order, lb.	343,000	358,600
Tender, fully loaded, lb.	212,200	305,600

On the basis of the J-1 test results, the experience accumulated with the altered locomotives of this class, and other considerations, the general objectives for the new design were set as follows: (1) Maximum cylinder horsepower approximately 20 per cent greater at a much higher speed; (2) boiler pressure 275 lb. per sq. in. versus 225 lb. per sq. in.; (3) equal main-engine starting tractive force, with some additional help from booster because of increased pressure; (4) boiler and superheater proportioned for higher capacity demand and to insure ample supply of steam under all conditions; (5) approximately same over-all length and clearance limitations; (6) highest capacity tender possible within the then total length limitation, and (7) least possible increase in weight, and weight distribution no less favorable from track standpoint.

Careful study of the situation indicated that, with the utmost attention to all details of design, these objectives could be attained and still adhere to the 4-6-4 wheel arrangement rather than using another pair of driving wheels, thus effecting substantial savings in size, weight, first cost, and operating expense.

In the development of the new design, the cooperation given by The American Locomotive Company, the Superheater Company, the Timken Roller Bearing Company, and others was of the utmost value.

Fifty of these locomotives were built in the fall of 1937 and the spring of 1938,* ten of which were streamlined and five of these had roller bearings on main and side rods. The principal dimensions and proportions are shown in Table I. A large-volume steam chest with 14-inch diam. valves, similar to the J-1 class, was retained but the steam passages from dome to exhaust were enlarged in proportion to the cylinder area to provide free passage of the steam and reduce losses in transmission.

Special design and equipment features were as follows: Roller bearings applied to all wheels; reciprocating parts of special lightweight design; revolving parts reduced in weight; dynamic counterbalancing; reverse-gear cylinder located on center line of engine to assist in reducing irregularities or inequalities in valve travel due to deflection or other causes; speed recorder and cut-off selection equipment, and rubber twin-cushion double-acting draft gear at rear of tender to eliminate free slack in both directions of gear movement substituting controlled resiliency to obtain smooth and efficient operation of trains. The ten streamlined engines received tight-lock couplers. The requirements for increased cylinder power and consequent greater boiler capacity and higher working steam pressure, together with the roller-bearing equipment, improved brakes, additional sand-box capacity, and certain minor items, indicated a weight increase of about 14,750 lb. over that of the latest Class J-1e, but, as previously stated, one of the major objectives was to hold the weight as closely as possible to that of the J-1 class and to accomplish this the following features were incorporated in the design: Nickel-steel boiler-shell sheets; cast-steel unit-bar grates; high-tensile steel drop coupler; USS Cor-Ten steel main air reservoirs; aluminum cab, running boards, casings, and gage board; magnesia-block lagging of light weight; tubes and flues to close tolerance; booster exhaust piped to tender instead of to stack; integral cast-steel frames and cylinders, cradle, engine-truck and trailing-truck frames of lightened design; lightweight new-design valve gear, and lightweight reciprocating parts and alloy-steel rods which also contributed to the saving in weight.

The resulting weight reduction amounted to 13,350 lb., making the net addition only 1,400 lb. with a total weight of engine in working order of 360,000 lb., of which 201,500 lb. were placed on the drivers. With this

* "The New York Central Receives Fifty Powerful 4-6-4 Locomotives," *Railway Mechanical Engineer*, May, 1938, pp. 165-173.

Table III—Performance of J-3 Class Locomotive Compared With J-1 Class

	Maximum power		Improvement,
	J-1	J-3	J-3, per cent
Tractive force with booster, lb.	55,100	55,000	...
Main engine tractive force, lb...	45,400	45,000	...
Main engine drawbar pull, lb...	41,300	41,500	...
Cylinder horsepower	3,900	4,725	21.10
	at 67 m.p.h.	at 75 m.p.h.	11.90
Cylinder horsepower per pair of driving wheels	1,300	1,575	21.10
Drawbar horsepower	3,240	3,880	19.75
	at 58 m.p.h.	at 65 m.p.h.	12.10
AVERAGE PERFORMANCE, DIVISION RUN OF 140 MILES			
Number of cars and weight in tons	18—1,244	18—1,253	...
Working speed, m.p.h.	55	59	...
Firing rate, dry coal per hr., lb.	6,940	6,419	...
Water delivered to boiler per hr., lb.	57,200	54,900	...
Exaporation per pound of dry coal, lb.	8.24	8.32	1.00
Combined efficiency; boiler, feed-water heater, and superheater, per cent	74.60	76.30	2.30
Steam per indicated horsepower-hour, lb.:			
Cylinders only	15.44	14.76	4.40
Including auxiliaries	17.28	16.89	2.30
Dry coal per indicated horse power-hour, lb.:			
Cylinders only	1.94	1.84	5.15
Including auxiliaries	2.10	2.03	3.30
Coal fired per car mile, lb.....	7.03	6.21	11.70
Weight per indicated horse-power, lb.	90	76	15.50
Based on weight of engine in working order, as tested, lb.	352,000	360,000	...

total weight and the distribution obtained, together with the use of reduced-weight rotating and reciprocating parts and dynamic counterbalancing, the calculated stresses on the track structure were satisfactory and well within permissible limits.

Performance and Capacity Tests, J-3 Versus J-1

The tests of the J-3 were conducted with engine No. 5408 during the last three months of 1937, over the Mohawk Division under regular service conditions of operation, the trains consisting of 22, 17, and 10 cars, which, with the dynamometer car, furnished weights back of the tender of 1,609, 1,244, and 766 tons, or heavy, medium, and light weight trains.

The principal results of representative performance are given in Table III, the figures for the class J-1 being repeated for ready comparison.

The drawbar pull and drawbar horsepower throughout the speed range are included in Fig. 2, with other types for comparison. Fig. 3 also shows the cylinder tractive effort and horsepower for the J-3a class only.

While the same main-engine starting tractive effort has been obtained in the new design, as desired, the drawbar pull at 70 m.p.h. has increased nearly 25 per cent, and the maximum drawbar horsepower is 20 per cent greater at a speed 12 per cent higher than the J-1. Coal and steam consumption per horsepower-hour have been decreased with a reduction of 15 per cent in weight per horsepower. An average thermal efficiency of 6.06 per cent at the drawbar was obtained for a complete division run, corresponding to 9.6 per cent at the cylinder.

Thermal Efficiency at Tender Drawbar Referred to fuel

Reference to this value for the conventional-design steam locomotive usually affords an opportunity for considerable argument, although it is a fact that, during recent years, gradual improvement in this respect has been achieved.

Without questioning the fact that it is highly desirable to improve this performance characteristic, it is prudent to review some of the reasons for the relatively low thermal-efficiency value, and to consider the practical advantages inherent in this form of motive-power plant.

The conventional locomotive is a noncondensing self-contained and self-propelled unit, confined within close and definite limits of weight, height, width, and in most cases length, because of operating clearance and load limitations. The necessarily high horsepower requirement naturally is accompanied by a high combustion rate and B.t.u. heat release per cubic foot of firebox volume per hour. Furthermore, this complete power plant, including all auxiliary equipment and its own fuel and water supply, is handled successively by different crews of only two men each at high speeds in dense traffic under widely and rapidly fluctuating load requirements.

Steam-locomotive efficiency at the tender drawbar is affected by the non-power-producing wheels and by the weight carried thereby. The modern tender when fully loaded may represent the equivalent of one and a half loaded 70-ton coal cars or more. However, the hauling of this nonadhesive weight is amply justified through sustained power output and the attendant advantages obtained.

Simplification of design, particularly with respect to cylinders and valve gear, penalizes the thermal efficiency, but repayment is secured and augmented in terms of high serviceability and reasonable freedom from excessive maintenance troubles. Moderate first cost for an active motive-power unit is essential unless the net return on additional investment can be clearly established. The measure of the value of a locomotive is its use, idle motive power representing a total loss of investment and

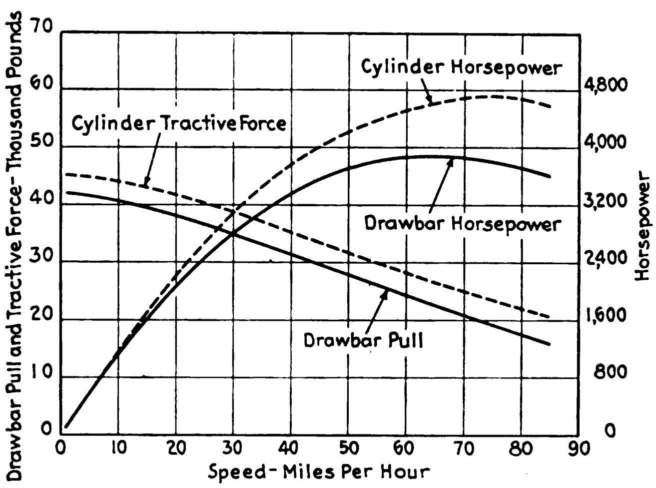
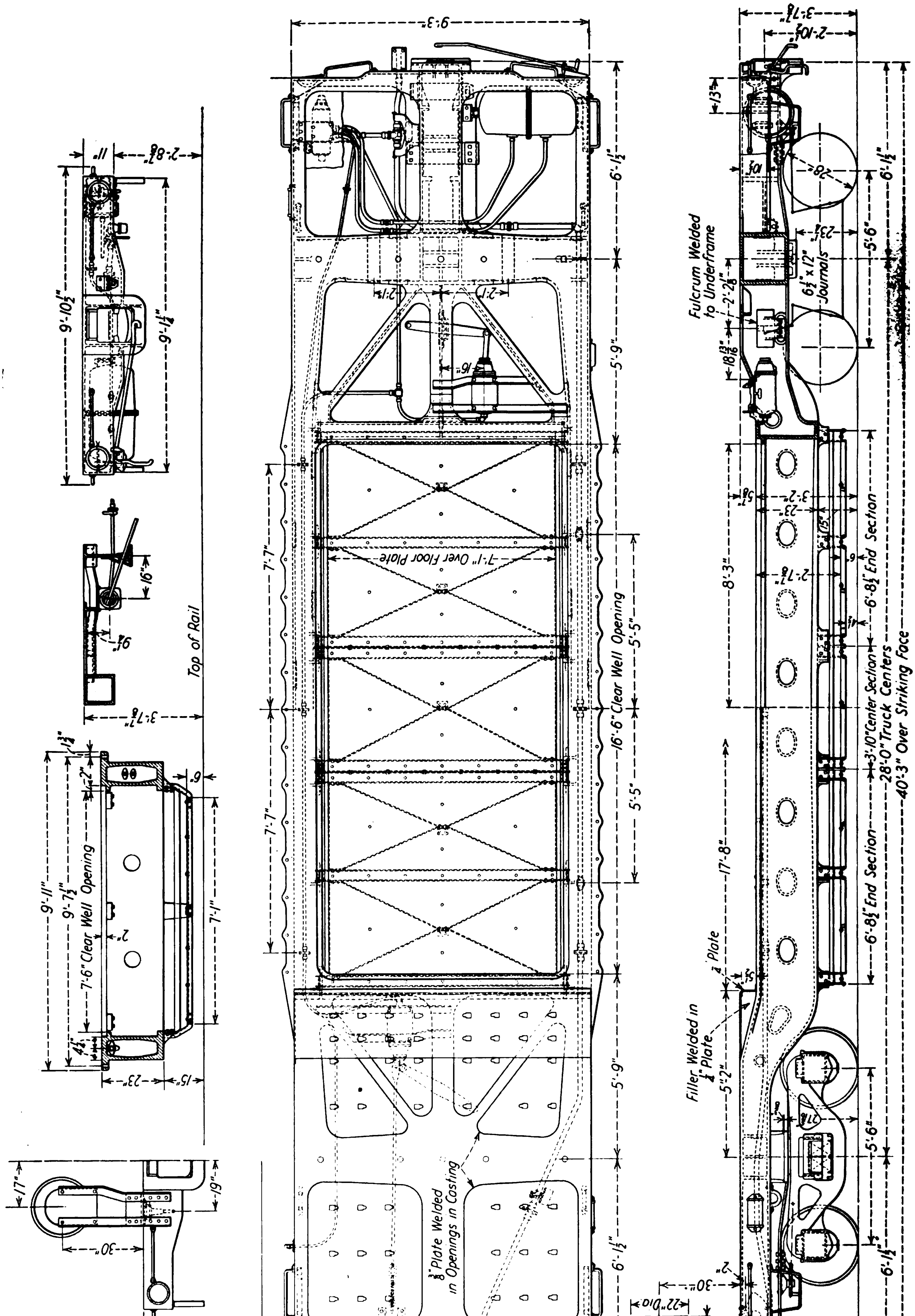


Fig. 3—Tractive force and horsepower vs. speed; and drawbar pull and horsepower vs. speed for Class J3A locomotives

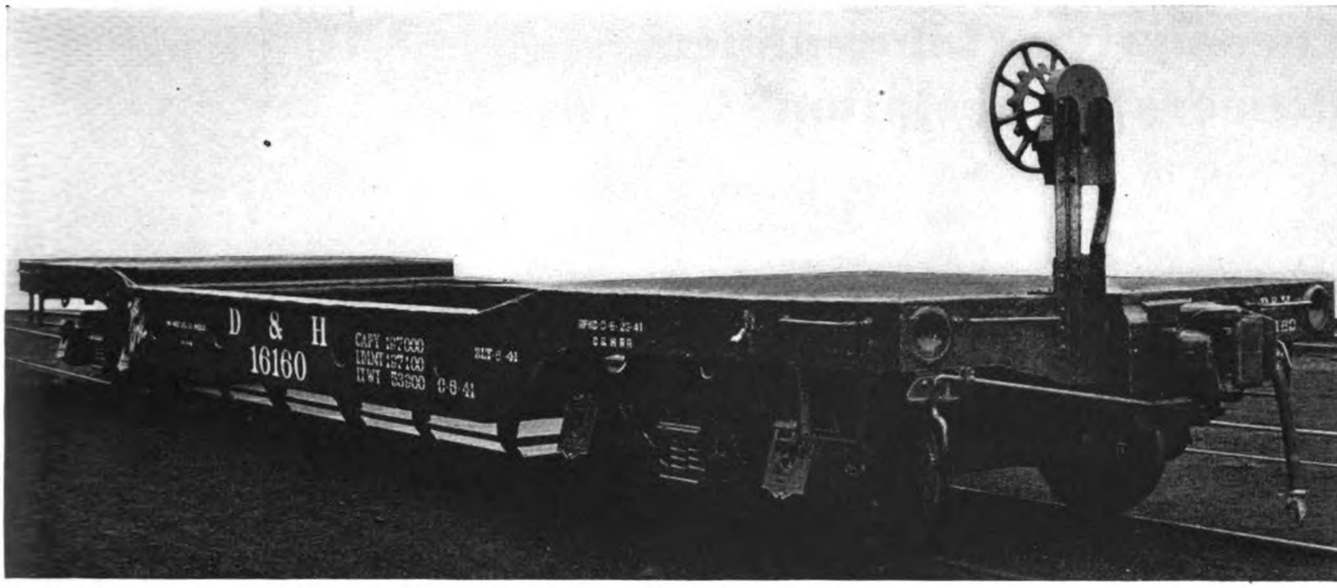
a constant expense. It is currently demonstrated that economically, maximum over-all performance efficiency is secured through the use of a unit capable of providing uninterrupted service and consistently high mileage throughout its life, with the best available design of boiler, cylinder, and related parts to fulfill these conditions.

As previously noted, the J-3 class was equipped with roller bearings throughout, including the driving wheels. The possibility was recognized that forced vibrations of the unsprung mass of the closely fitted roller-bearing driving-wheel assemblies caused by the overbalance and the elastic foundation of the track structure might be sufficient during high-speed slipping to cause the wheels to lift from the rail.

(To be concluded)



Plan, elevation and cross-sections of Delaware & Hudson well-hole car



Delaware & Hudson

Well-Hole Car

These cars of 98-ton nominal capacity have Commonwealth one-piece cast-steel underframes and are designed especially for the transportation of heavy electrical equipment

THE first of five 98-ton well-hole cars being built at the Oneonta, N. Y., car shops of the Delaware & Hudson was completed and placed in service during the latter part of June. These cars were ordered to meet the demands of increased traffic and were designed especially for the transportation of heavy electrical equipment such as transformers, dynamos and generators. They have a light weight of 53,900 lb. and a load limit of 197,100 lb. The over-all length is 40 ft. 3 in. with a clear well opening 16 ft. 6 in. long and 7 ft. 6 in. wide.

The cars have Commonwealth cast-steel one-piece underframes and a steel platform at each end of the car. The platforms were formed by welding ⅜-in. plates in the casting openings flush with the top of the underframe. The sloping intersections of the platforms with the center portion of the underframe, the top of which is 5½ in. below the level of the platforms, were boxed in by welding a ¼-in. Z plate across the width of the car to support a ⅜-in. top plate. This arrangement extends the platforms an additional 23¾ in. toward the center and also encloses the brake cylinders. All brake pipes are carried through the center portion of the side-sill members which protects them from damage by the lading.

Principal Weights and Dimensions of the Delaware & Hudson Well-Hole Car

Light weight, lb.	53,900
Load Limit, lb.	197,100
Total weight at rail, lb.	251,000
Weight of underframe, lb.	26,200
Weight of one truck, lb.	10,100
Journals, ft.-in.	6½ x 12
Wheels, multiple wear steel, in.	28
Length over strikers, ft.-in.	40-3
Width over-all, ft.-in.	9-11
Well opening, width, ft.-in.	7-6
Well opening, length, ft.-in.	16-6
Well opening, depth, ft.-in.	2-7⅞
Height, rail to top of end platforms, ft.-in.	3-7⅞
Height, rail to top of side sill at well, ft.-in.	3-2

The load carried in the well opening is supported on the underframe longitudinal side-sill members. The bottom of the well is covered by steel plates as a safety measure and also as a means of protecting the lading against dirt and cinders. In the event additional clearance is required, the center sections of these protecting plates may be removed. Holes in the steel platform and the sides of the underframe at the well opening are provided for attaching the rods or cables used to hold the lading in place.

The cast-steel trucks have integral frames with 28-in. multiple-wear steel wheels and 6½-in. by 12-in. axle journals. Miner Type A-22-XB draft gears were applied to the cars. The air-brake equipment consists of two sets of AB brakes with 7½-in. by 12-in. cylinders while one Ajax geared hand brake is furnished for manual braking. Other equipment includes Creco No. 4 brake beams and four-point brake-beam supports, coil spring groups with Symington-Gould snubbers, swivel-butt rotary-operated couplers, Union centering devices and Wine brake balancers. The principal weights and dimensions are given in the table.

Locomotive Maintenance Officers' Association

Hotel Sherman, Chicago

Tuesday, September 23

Morning Session

9:30 o'clock Joint meeting of the Coordinated Associations—Address by V. R. Hawthorne, executive vice-chairman, Mechanical Division, Association of American Railroads.

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10:30 o'clock Report of Committee on Maintenance of Air Brake Equipment—J. P. Stewart (chairman), general supervisor air brakes, Missouri Pacific Lines.

Afternoon Session

2:00 o'clock Report of Secretary-Treasurer

Report of Committee on Apprenticeship—Roy V. Wright (chairman), editor, *Railway Mechanical Engineer.*

Report of Committee on Constitution and By-Laws.

Election of officers.

Wednesday, September 24

Morning Session

9:00 o'clock Report of Committee on Improved Locomotive Repair Practices—N. M. Trapnell (chairman), assistant superintendent of motive power, Chesapeake & Ohio.

Report of Committee on Shop Tools.

Afternoon Session

2:00 o'clock Report of Committee on Lubrication—J. R. Brooks (chairman), supervisor of lubrication and supplies, C. & O.

Report of Committee on Membership.

Installation of new officers.

Remarks by retiring president.

Remarks by incoming president.

Master Boiler Makers' Association

Hotel Sherman, Chicago

Tuesday, September 23

Morning Session

8:00 o'clock Registration*

9:30 o'clock Joint meeting of the Coordinated Associations—Address by V. R. Hawthorne, executive vice-chairman, Mechanical Division, Association of American Railroads.

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10:45 o'clock Opening session Master Boiler Makers' Association.

10:50 o'clock Address by President C. B. Buffington.
Secretary-Treasurer's report
Report of the Committee on Law
New business.
Routine business

Afternoon Session

1:30 o'clock Address by C. B. Hitch, superintendent of motive power, C. & O.

Topic No. 2. Application and maintenance of flues, tubes, and arch tubes—Frank A. Longo (chairman), general boiler inspector, Southern Pacific System.

Topic No. 4. Application of straight vs. tapered radial staybolts, taper per foot, taps and reamers used, and service that is being obtained, coal and oil-burning locomotives—R. W. Barrett (chairman), chief boiler inspector, Canadian National.

Routine business.

Wednesday, September 24

Morning Session

8:30 o'clock Registration.

9:00 o'clock Routine business.

Topic No. 5 (Continued from 1940). Application of iron, steel, and alloy rivets, with recommendations as to the proper methods of heating and driving—A. G. Trumbull (chairman), chief mechanical engineer, Advisory Mechanical Committee, C. & O.

Topic No. 3 (Continued from 1940). Treating feed water chemically—Carl A. Harper (chairman), general boiler inspector, C.C.C. & St. L.

Afternoon Session

1:30 o'clock Topic No. 3 continued.

Topic No. 1. Shop kinks and new ways of doing things in the boiler shop—S. Christopherson (chairman), supervisor of boiler inspection and maintenance, N.Y. N.H. & H.

Report of special committees.
Report of Executive Committee.
Report of Committee on Memorials.
Report of Committee on Resolutions.
Election of officers.

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*Registration also Monday, 4:30 to 6:00 p. m., Rooms 1508-1510.

Car Department Officers' Association

Hotel Sherman, Chicago

Tuesday, September 23

Morning Session

8:00 o'clock Registration.

9:30 o'clock Joint meeting of Coordinated Associations—Address by V. R. Hawthorne, executive vice-chairman, Mechanical Division, Association of American Railroads.

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10:30 o'clock Meeting called to order.
Approval of minutes of last annual meeting.
Address by President A. J. Krueger, superintendent car department, N.Y.C. & St.L.

Reports of District Membership Committees.
Report of Secretary-Treasurer.
Unfinished business.
New business.

Afternoon Session

1:30 o'clock Report of Publicity Committee.

Address by E. B. Hall, chief mechanical officer, C. & N.W. and C.St.P.M. & O. Subject: Cooperation between Railroads and Departments of Railroads.

Report of Freight- and Passenger-Car Maintenance Committee—J. E. Keegan (chairman), chief car inspector, Pennsylvania.

Report of Shop Operation, Facilities and Tools Committee—R. K. Betts (chairman), foreman car repairs, Pennsylvania.

Report of Passenger-Train-Car Terminal Handling Committee, C. P. Nelson (chairman), general foreman, C. & N.W.

Report of Lubricants and Lubrication Committee—J. R. Brooks (chairman), supervisor lubrication and supplies, C. & O.

Wednesday, September 24

Morning Session

8:00 o'clock Address by W. D. Beck, district manager, Car Service Division, Association of American Railroads. Subject: Conservation of Equipment.

Report of Freight-Car Inspection and Preparation for Commodity Loading Committee—H. E. Wagner (chairman), general car foreman, Missouri Pacific.

Address by D. S. Ellis, chief mechanical officer, C. & O., Pere Marquette, and N.Y.C. & St.L. Subject: Better Freight-Car Maintenance.

Report on Interchange and Billing for Car Repairs—E. G. Bishop (chairman), general foreman car department, Illinois Central.

Afternoon Session

1:30 o'clock Report of A.A.R. Loading Rules Committee—H. T. DeVore, (chairman), chief interchange inspector, Youngstown Car Inspection Association.

Report of Painting Committee—C. L. Swing (chairman), general foreman, Pullman-Standard Car Manufacturing Company.

Report of Booster Committee—W. J. Demmert (chairman), sales agent, Griffin Wheel Company.

Report of Reception Committee.

Report of Nominating Committee.

Election of officers.

Railway Fuel and Traveling Engineers' Association

Hotel Sherman, Chicago

Tuesday, September 23

Morning Session

8:00 o'clock Registration.

9:30 o'clock Joint meeting of the Coordinated Associations—Address by V. R. Hawthorne, executive vice-chairman, Mechanical Division, Association of American Railroads.

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10:30 o'clock Address by President A. A. Raymond, superintendent fuel and locomotive performance, N.Y.C.

Appointment of special committees.

Plugged netting—Cause and Cure—H. L. Malette (chairman), road foreman of equipment, St.L.—S.F.

The Road Foreman and the Diesel Locomotive—W. D. Quarles (chairman), general mechanical instructor, A.C.L.

Fuel Records and Statistics—E. E. Ramey (chairman), fuel engineer, B. & O.

Afternoon Session

2:00 o'clock Air brakes—J. A. Burke (chairman), supervisor air brakes, A.T. & S.F.

(a) High-speed breaking with D-22 control valves—H. I. Tramblie, air-brake supervisor, C.B. & Q.

(b) Terminal tests in road handling on long freight trains with mixed K and AB brake equipment—F. T. McClure, assistant air-brake supervisor, A.T. & S.F.

(c) The elimination of moisture and oil in the air-brake system—F. Ellis, general air-brake instructor, St.L.—S.F.

Wednesday, September 24

Morning Session

9:00 o'clock Locomotive performance as Affected by Steam Distribution—J. L. Ryan, mechanical engineer, St.L.—S.F.

Turbine and condensing Locomotives—L. P. Michael, (chairman), chief mechanical engineer, C. & N.W.

Address by L. Richardson, mechanical assistant to vice-president and general manager, B. & M.

Coal—Utilization of the Various Sizes—S. A. Dickson (chairman), supervisor fuel, Alton.

New Locomotive Economy Devices—A. G. Hoppe (chairman), assistant mechanical engineer, C.M.St.P. & P.

Utilization of Motive Power—A. A. Raymond (chairman), superintendent fuel and locomotive performance, N.Y.C.

Afternoon Session

2:00 o'clock Fuel Economy from the Viewpoint of the Water Engineer—R. C. Bardwell, superintendent water supply, C. & O.

Lubrication—W. R. Sugg (chairman), superintendent fuel conservation and lubrication, Missouri Pacific.

(a) Lubrication of valves, cylinders and steam auxiliaries.

(b) Forced feed and automatic lubrication of machinery.

Report of Secretary-Treasurer.

Election of Officers.

Reports of special committees.

Other business.

EDITORIALS

Cleaning Modern Streamliners

Modern streamline passenger equipment has been installed primarily to build up railway prestige and increase passenger-train earnings by providing fast and safe transportation in cars which are comfortable, convenient, pleasingly designed and decorated to a degree never before attained in railway history. Railway passenger trains are operated often, and in fact most of the time, under more or less adverse climatic and atmospheric conditions, and the most perfect cars ever built, from a mechanical standpoint, will not long prove satisfactory to passengers unless an organized program of exterior and interior cleaning is developed and conscientiously followed. It is gratifying to note that one of the important committee reports which will be presented at the September 23 to 24 meeting of the Car Department Officers' Association at Chicago, will be devoted to the maintenance of streamline equipment and include two extensive sections on exterior and interior car cleaning.

Not every one realizes how much it costs to keep modern passenger equipment, including streamline trains, clean. From a recent rather limited survey, this cost apparently averages between $3 and $5 per car for current daily cleaning. Obviously, some classes of cars cost more to clean than others and on one railroad operating stainless-steel equipment, the following average daily costs were reported: Baggage-mail car, $1.44; baggage-dinette, $3.58; 78-seat chair car, $4.32; chair-parlor car, $5.15. These figures include both labor and material and 20 per cent allowance for supervision. The average cost for exterior and interior cleaning of the four cars mentioned was $3.60 per car per day.

On another railroad using streamline passenger equipment, embodying primarily welded USS Cor-Ten steel construction, the cleaning cost per car per day was as follows: Exterior cleaning, $1.63; interior cleaning, $2.18; train supplies, $.55; cleaning materials, $0.24; or a grand total of labor and material cost of $4.60 per car per day.

On the first road mentioned, it is estimated that 75 per cent of the actual cleaning cost is chargeable to cleaning car interiors and that one-third of this amount is expended for various operations required in cleaning the upholstery in the carpets. More accurate figures on the second road show that 58 per cent of the total number of man hours required for cleaning a modern passenger train are needed to clean the car interiors. Experience on this road indicates that at least 50 per cent of the interior car cleaning cost is required for cleaning the seat upholstery and carpet. Washing constitutes by far the larger part of the exterior cleaning cost, amounting to about twice the cost of cleaning the windows, trucks, etc.

The general method of cleaning upholstery fabrics and carpets is to clear them daily of dust and dirt, mainly with an efficient vacuum cleaner, and remove any badly-soiled spots with carbon tetrachloride or the equivalent. At more or less regular periods of three to six months as required, the upholstery should be thoroughly cleaned, preferably with an efficient rug shampoo, the car being taken out of service long enough to allow for drying or else have replacement cushions and carpets available to install.

With modern streamline passenger cars intensively used on close schedules, especially during the summer rush season, the problem of getting enough time to perform necessary cleaning operations is no small one. Some railroads have found that the solution of this problem is what might be called *current maintenance,* including the use of replacement cushions and carpets to avoid taking the cars out of service for extensive cleaning operations. With a layover period of only two to three hours each day at main terminals, for example, it is entirely practicable to replace a carpet and a dozen sets of seat cushions, one or more cars being thus completely re-conditioned each week. Keeping this expensive modern equipment in revenue-earning service, without frequent shopping for repairs or heavy cleaning operations, is very much in the interests of increased railway earnings and reduced expenditures.

Scrutinizing The Scrap Pile

On page 330 appears a brief account of a conference held at Washington early in July at which OPM plans for the location and return for remelting of scrap steels containing a number of alloying elements, particularly nickel, were announced and discussed. The nickel-steel supply problem has become particularly acute. As announced at this meeting, the total demand in the United States is now running about twenty-one million pounds a month, of which about twelve and one-half million pounds are required on A priority ratings. The total available supply is fifteen million pounds per month. Facing such a situation, the logic of turning to the scrap pile is obvious.

In the production industries using nickel and other alloy-steel forgings, as much as from 20 to 40 per cent of the material is removed in machining. The preparation of these turnings for return to the steel industry

is one of the problems under study. Most of the alloy steels used by the railroads are in the form of locomotive or car forgings. They appear in the scrap pile largely in the form of heavy remelting scrap and offer no serious problem of preparation for shipment and remelting. The only problem facing the railroad is that of suitable segregation according to the amount and combination of alloying elements in the steel.

The extent to which such scrap will be returned by the railroads in suitable form to prevent the loss of the critical alloying elements will depend upon how much special effort will be justified in segregating and protecting these scraps from contamination, by the price differential which such scraps command. The possibilities for a net financial return on the operation, however, are great enough to justify a thorough study of this situation guided by the recommendations for grading which have recently been issued by the Office of Production Management.

Let's Look At the Record

Nearing completion of its fourth year of service, four-fifths of the test period prescribed by the Interstate Commerce Commission, the Delaware & Hudson's fusion welded boiler maintains unbroken its record of 100 per cent performance. With a monotonous repetition of content, the progress reports on this test have merely verified that which many have never doubted, the ability of welding to meet successfully the requirements of safe locomotive boiler construction. In approaching the last year of the test period, the performance of this boiler again focuses attention on fusion welding as a solution of many of the vexatious problems facing boiler designers and boiler maintainers alike.

A listing of these problems would be fundamentally a recitation on the limitations of riveted boiler construction. These were reviewed most forcefully by A. G. Hoppe, assistant mechanical engineer, Chicago, Milwaukee, St. Paul & Pacific at the A. A. R. Mechanical Division meeting in St. Louis in his discussion of the report on locomotive construction, which appeared in last month's issue. Of particular interest, however, was the plea made by Mr. Hoppe in concluding his discussion that there is an immediate need of utilizing welded construction for locomotive boilers. It is an indication that responsible engineers view welding as a reliable medium by which present limitations on progress in boiler construction can be removed.

At both the Mechanical Division meeting and the railroad sessions of the American Society of Mechanical Engineers, at Kansas City on June 17, James Partington, manager engineering department, American Locomotive Company, discussed the development and the advantages of welded boilers. As a member of the A. S. M. E. Boiler Code Committee of long standing and chairman of its subcommittees on Locomotive Boilers and Welding, Mr. Partington is an authority on this subject. While they may be familiar to many, his concise enumeration of the advantages obtained with the welded locomotive boiler at the A. S. M. E. meeting are well worth repeating. These are: no rivets, no overlaps, no obstruction inside or outside, no joint repairs or failures, lower maintenance expense, higher efficiency, lighter weight, easier handling, quicker washing, neater appearance, and lastly, the elimination of caustic embrittlement. The net result is a better boiler producing greater availability of the steam locomotive.

It should be noted that the active development of plans for the Delaware & Hudson's fusion welded boiler was first started in 1935. Since that year, advances in welding technique have been so great that it has been difficult for the various codes to keep pace with its rapid progress. With this additional knowledge and skill, it seems logical to expect that locomotive boilers fabricated by competent welding operators in accordance with the latest procedure and test methods would produce performance records as impressive as those of the first fusion welded locomotive boiler. What more could be expected?

Constructive Air Brake Papers Being Prepared

It is not too early for air brake supervisors generally to make plans for attending the annual meeting of the Railway Fuel and Traveling Engineers' Association which will be held at Chicago this fall. Recognizing the vital necessity of adapting air-brake performance to modern requirements and securing uniformly satisfactory brake performance, the subjects committee and officers of the association have greatly strengthened the program of the annual meeting by including air brake subjects of great interest to supervisors throughout the country and arranging to present information which these men can ill afford to miss if their respective railroads are to keep abreast of the times in braking heavy fast trains with maximum efficiency.

The air-brake subjects, scheduled for presentation this year by an unusually competent and experienced committee, are divided into three parts for the purpose of concentrating discussion on three particularly pressing current problems relating to air-brake equipment and its operation. The first subject "High-Speed Braking With D-22 Control Valves," will be presented by a railroad air-brake supervisor who has had a vast amount of experience with the braking of high-speed trains and who has co-ordinated the experience of an able subcommittee in preparing this section of the committee's report. The "Terminal Testing and Road Handling of Long Freight Trains With Mixed K and AB Equipment," is the second subject, also being prepared by a competent subcommittee under the leadership of a former road foreman of engines who is now assistant supervisor of air brakes. The "Elimination of Mois-

ture and Oil From the Air Brake System," will be presented by an experienced subcommittee under the direction of a general air brake inspector and represents the composite thought of both air-brake companies and railroad specialists.

In the absence of any national meeting of air-brake supervisors this year, it is apparent that community of interest and the possibility of exchanging experiences regarding air-brake problems of vital importance make it highly desirable for railway managements to send their air-brake supervisors to this meeting of the Railway Fuel and Traveling Engineers' Association. The details of the program for the annual meeting are shown elsewhere in this issue.

Factors in Steam Locomotive Improvement

It is a generally accepted fact that tremendous changes have been made in the steam locomotive during the past fifteen or twenty years. Just how extensive these changes have been and what they have accomplished in the way of increased capacity, increased reliability, and reduced costs of maintenance were set forth in two papers presented before the semi-annual meeting of the A. S. M. E. held at Kansas City, Mo., during June of this year. The first installment of one of these papers, by P. W. Kiefer, chief engineer motive power and rolling stock, New York Central, appears elsewhere in this issue. It will be completed in a latter issue and will be followed by an abstract of the paper by A. A. Raymond, superintendent fuel and locomotive performance, New York Central. Together, these papers constitute a remarkable record of a 15-year period of intensive study and improvement of steam passenger motive power on a single railroad and the kind of performance which can be obtained from the current designs which that effort has evolved.

Following the building of the first 4-6-4 type locomotives, Mr. Kiefer cites a steady procession of changes in the design applied successively as more of these locomotives were ordered, until a complete revision of the design produced the present J3 class, the first of which were built in 1937. These changes have contributed to reliability, economy, and capacity. They include the installation of roller bearings on all engine and tender trucks; the application of dynamic counterbalancing to reduce track effects; speed-recording and selective cut-off equipment to effect greater utilization of capacity, the installation of cast-steel engine beds to increase reliability and continuity of operation with a substantial reduction in maintenance cost; the use of nickel-steel boilers to reduce weight and permit higher boiler pressures; further improvement in counterbalancing by the use of lightweight roller-bearing reciprocating and rotating parts; the installation of roller-bearing driving boxes; enlarged steam passages in proportion to increased cylinder area, and the use of USS Cor-Ten steel and aluminum for various parts to effect further reductions in weight.

The objectives of the complete revision of the 4-6-4 type design were a 20-per cent increase in maximum drawbar horsepower at a much higher speed over the capacity of the first design of this type, which developed a maximum drawbar horsepower capacity 28 per cent higher at a speed 29 per cent above that of the last design of Pacific type on the New York Central.

How effectively the features enumerated have contributed to making these locomotives with their increased power more reliable, more capable of sustained service, and less costly to maintain is brought out in Mr. Raymond's paper in which is recorded striking reductions in engine failures and marked increases in miles per locomotive per month.

It will be noted that the developments recorded in Mr. Kiefer's paper conservatively adhere to a basic design made up of conventional elements, but that improvements and refinements in the design followed each other rapidly throughout the twelve years which elapsed between the building of the first 4-6-4 locomotive of the J1 class and the complete redesign of the type to produce the J3 class. Is there any reason to believe that the J3 class locomotives, refined as they are by comparison with their predecessors, are going to be spared the processes of change and improvement any more than their predecessors, which, in the minds of their designers, at least, were obsolete almost before the first lot were delivered?

New Books

HEATING, VENTILATING, AIR CONDITIONING GUIDE. *1941 Edition. Published by the American Society of Heating and Ventilating Engineers, 51 Madison Avenue, New York. Leatherette Cover. 808 text and 260 catalog data pages. Price, $5.*

To those who have occasion to deal with problems of heating, ventilation and air conditioning in connection with buildings this Guide has long been too well known to need any detailed description of its qualities. This Nineteenth Edition contains a chapter on Transportation Air Conditioning in which the fundamentals of railway passenger car air conditioning are discussed. While the major part of the data in the book pertains to the problems encountered in buildings there are numerous chapters of real interest to the railroad passenger-car designer or to those who deal with the design or installation of air-conditioning apparatus. From the text and tables contained in such chapters as those on thermodynamics, heat transmission coefficients, heating and cooling load, fans, air distribution, duct design and insulation, can be secured most of the basic information that is of interest to railway passenger-car air-conditioning engineers.

GOOD, BAD AND INDIFFERENT

by **Walt Wyre**

"DID any of the machinists that were notified to report for work answer yet?" Jim Evans, roundhouse foreman for the S. P. &. W., asked.

"Three out of the five we wrote answered," John Harris, the roundhouse clerk, said, "Anderson is working for the government in the arsenal at Rock Island. From what he says he must have a pretty good job because he is going to stay on it. Bailey says he will report within the required thirty-day period and Caldwell will be in to go to work the nineteenth."

"About as I expected," Evans frowned as though he had bitten into a crab apple. "All of the best men that were cut off are working on good jobs. We get what's left and not enough of them. Caldwell never was a mechanic and never will be. Bailey is not much better. I knew that when they were serving their time. The three of them started here in Plainville at about the same time."

"Looks like apprentices must come in bunches of three," John Harris observed. "We are putting on three new ones now."

"Guess that's right, and the railroad will be lucky to get one good mechanic out of the three." Evans had a far away look in his eyes as though remembering the time when other apprentices had started to learn the machinist trade seven years before.

Railroad business wasn't so good then but officials, hoping for better times when mechanics would be needed, had put on a few apprentices. Most shop foremen in the hopes of getting some low-priced labor as a relief for dwindling allowances had encouraged the idea. The young men, pleased with prospects of four years steady employment even at the low rates received by apprentices, were anxious for the jobs. Nobody involved was very seriously concerned about the future until passing time made what had been a very uncertain future then a mighty urgent present with undreamed of demands becoming more urgent as each European country falls like an infested tree with a worm eaten heart.

There were many applications when it became known that the S. P. & W. was going to put on some apprentices at Plainville in 1934. Ed Caldwell was the first one put on. His father was machinist chairman and president of the local shop committee. Young Bailey was hired next. Maybe the fact that the night roundhouse foreman was going with Bailey's good-looking sister didn't have anything to do with the boy getting the job, but it might have, and it's fairly certain that Bailey's father, who worked on the labor gang, didn't have a lot of influence. After the first two machinist apprentices were selected, the master mechanic had considerable difficulty deciding who to recommend for the third and last one. At least a dozen applications were on file. Among them, the least considered was Anderson. Nobody had pushed the application except the boy's dad who was, as now, a quiet, retiring sort of fellow who always falls heir to any jobs that other machinists are afraid to tackle and does them as part of his job and not worth mentioning. The senior Anderson told Jim Evans one day that he thought his boy Dan would make a good machinist if given a chance. Evans agreed, but being busy with other things forgot to mention it to the master mechanic.

A hardware merchant of the town was indirectly responsible for Dan Anderson being selected. One day the master mechanic was walking down Main Street when he was attracted by a display of tools in the hardware store window. In the center of the display there was a model of an S. P. & W. 5000 Class locomotive. It was complete in every detail, even to valve gear and brake rigging. On a card leaning against one of the drivers was lettered, "Built by Dan Anderson."

The merchant happened to come to the door and noticing the master mechanic admiring the display walked over and spoke to him. "Quite a neat job for a boy, don't you think?" the merchant said.

"For a boy," the master mechanic repeated, "Anderson is not a boy; he is a machinist over at the roundhouse."

"But his boy built that locomotive," the merchant said. "They live next door to us," he added.

Next day the master mechanic sent for young Anderson and after talking with the boy a few minutes decided to put him on as the third apprentice.

When the boy started to work he found Caldwell working in the machine shop and Bailey working with the air man. The newest apprentice was placed on the drop-pit. Each of the three boys was very nearly of the same age. They had finished high school together, and had just about equal opportunities, but even a casual inquiry of school records and tendencies would have shown that two of them were square pegs uncomfortably fitted in round holes.

Bailey could make a Latin verb sit up and beg to be conjugated. Some of the themes he had written showed evidence of journalistic aptitude and the school paper won several prizes the year he was editor. Mathematics was a mystery to him and he worried little about it. So far as he was concerned, the area of a circle could be the altitude multiplied by the square root of the hypotenuse, and if it wasn't, what difference did it make?

Caldwell never could make up his mind what he wanted to study in school and was constantly worrying the principal to let him change classes. The teachers had it in for him and when the principal wouldn't allow him to change, then the principal had it in for him too. They let Caldwell graduate because they didn't want to bother with him another year.

Anderson was pretty dumb in English and managed to scrape through Spanish because a foreign language was required. He might have made better grades in these subjects if he had not spent practically all of his spare time in the manual training shop. Mathematics was a hobby and he delighted to confuse the teachers by using methods not found in the text book.

At any rate, regardless of tendencies or vocational aptitudes, the three boys were indentured and it was up to the railroad to make mechanics out of them in four years. Scientists have made silk purses out of the proverbial sow's ears, but it's much easier to make better ones of more suitable material; besides, converting apprentices into full fledged mechanics is a secondary job of railroad supervisors, and they are not scientists either.

A representative of a correspondence school came to Plainville a short time after the apprentices were put on. Evans called the three boys in the office to talk to him about taking a course.

"The railroad company pays part of the cost of the course," the representative explained, "so you can see they want you to have it."

"It's a good thing," Evans agreed, "especially as we do not have any provisions for apprentice schooling here."

Anderson and Caldwell each took out a course. Bailey said he would think about it. After three months Caldwell decided to change the mechanical course he was taking to one in mechanical drawing which he dropped before he had learned the difference between an orthographic projection and an isometric drawing.

IN THE meantime the three apprentices were getting acquainted with grease and grime, smoke and noise and orderly confusion that is part of every roundhouse job. Caldwell started in like he was going to be a real machine hand. In ten days he was doing a fair job running an 18-in. lathe, then just as he was beginning to get on to the work he decided he wanted to do something else and became careless.

The foreman didn't know anything about it until he noticed several newly turned brass bushings in the scrap brass box. "What are those?" Evans asked machinist Cox, who usually made most of the bushings.

"Don't know," Cox replied. "Guess they are some that didn't fit."

"Did you make them?"

"I dont remember who made them," the machinist replied evasively.

Evans questioned other machinists with about the same result. Then he noticed the apprentice Caldwell who was boring a small steel bushing at the time. He was leaning with his right elbow resting on the tail stock of the lathe, indifferent to the chattering tool playing hysterical hop-scotch inside the steel tubing.

The foreman walked over to the lathe and stood and watched until the serrated cut was finished. "Let's look at that tool," Evans said. Caldwell stopped the machine and backed the tool out. "Just as I thought—too dull to cut even if it was set right. Have you learned how to grind a boring tool?"

"I thought I had it ground right," Caldwell replied, "but guess I didn't."

Evans showed the apprentice how to grind the tool and set it to cut without having a chill. Then, admonishing him to be more careful in the future, he went into the roundhouse.

When he came near the drop-pit, he saw Dan Anderson kneeling down on the cement floor and walked over to see what he was doing. The young man seemed to be doing his level best to see how many figures he could make on the cement with a piece of soapstone. He was so absorbed that he never noticed when the foreman came up.

"Doing a little arithmetic?" Evans asked.

Anderson rose quickly, color flooded his face red as a freshly painted caboose. "No—no,sir, that is—yes, sir. I was doing a little figuring."

"What were you figuring?"

Evans' evident interest seemed to relieve Dan's embarrassment. "We just finished running the valves on the 5083," Dan said, "and I was just seeing if I could figure the change Jenkins made."

"Don't you think Jenkins got it right?"

"I guess so," the apprentice replied, "but I can't make it come out like Jenkins did."

"Well, now is as good time as any for you to learn. Where is Jenkins?"

"On the other side of the engine," Anderson said.

"Go tell him to have the hostler line up an engine behind the 5083 and we'll run the valves over just to be certain."

Jenkins was somewhat peeved when it turned out that he had made a mistake in his fractions and that the raw apprentice had caught it.

Evans said to Anderson, "That's the way to do it! Don't take anybody's word for anything unless they prove it! The best of us make mistakes."

Bailey, after working with the air man sixty days, could have written a beautifully worded theme on the subject, but had to be shown each time how to put a gasket on a brake valve. He was a likeable fellow, though, and willing enough to follow instructions to the best of his limited mechanical ability, and no one but the machinist he was working with had any idea but that

the boy was well on his way towards being a first-rate mechanic.

At the end of six months, according to the apprentice schedule, the boys were supposed to be placed on different jobs. Caldwell, after persistent insistence, had already been moved to running repairs in the roundhouse. Bailey, being allergic to lathes and other machinery, wanted to postpone his introduction to them and asked to stay with the air man a little longer and wasn't exaggerating a bit when he told the foreman that there was still a lot he hadn't learned about air.

Anderson wanted to go into the machine shop but, on account of reduced allowance, it had been necessary to cut the drop-pit force to one machinist and the apprentice. Besides costing a lot less, Anderson was by then just about as good as a regular machinist on the drop-pit work. The result was Anderson spent ten months instead of the usual six on the drop-pit.

ONE Saturday when the 5092 was about ready to come off the drop-pit, Evans remarked to machinist Jenkins that if the engine was finished that afternoon he was going to run it on an extra Sunday to take out a short train of work-equipment cars which wouldn't need to run fast.

Young Anderson worked like he was fighting fire in a powder mill until four o'clock that afternoon when the engine was ready to go. The apprentice then went to the office and stood around fifteen minutes trying to get up nerve to talk to the foreman. Finally he raked up the nerve to stick his head through the doorway of the office where Evans was sitting at his desk looking over some work reports.

"Come in, Anderson," Evans said. "What have you got on your mind?"

Dan removed his cap and walked slowly into the office. "Nothing much," Anderson said as he twisted his cap into a wad. "Nothing much—I heard you say you might run the 5092 tomorrow."

"That's right," Evans said. "Is there anything wrong with her?"

"No, sir, at least, I don't think there is. I just wondered if I might ride the engine and see how it runs."

"But you are not working tomorrow," the foreman reminded him.

"No, sir, that's the reason I asked. I thought maybe you wouldn't mind if I rode it Sunday."

"Sure, I'll fix it up! The extra should get out about seven-thirty or eight o'clock. It may be pretty late Sunday night getting back though."

"I won't mind. I've always wanted to ride a locomotive—out on the road, I mean. Thank you." Anderson turned quickly and left the office in such a rush that he stumbled on the threshold.

MONDAY morning Anderson was on the job ready to go to work when the eight o'clock whistle blew, but the redness of his eyes told of a short night in bed. The register showed the 5092 arrived at 3:15 a. m.

"How did you like the ride?" Evans asked him about nine o'clock that morning.

"Just fine," Dan replied with enthusiasm. "I never did know before that a locomotive rattled around so much when it's running. Sure a lot of weight flying around when the main rods start whizzing on a locomotive going sixty miles an hour."

"You look a little sleepy. Better climb up in the cab and rest a bit until Jenkins needs you," Evans said.

"I haven't been helping Jenkins," Anderson said. "He's been out in the machine shop all morning working on something."

"Yes, he's building a winch to drag drivers in from the machine shop to the drop-pit. The electrician has located a spare five-horsepower motor to run the winch. Sure be lots easier than rolling them by hand like we have been doing, and safer, too."

"Five-horsepower?" Anderson repeated as if talking to himself. "That won't pull a pair of main drivers very fast, will it?"

"Oh, I don't know," Evans replied. "Looks like it should. Anyway, we can try it. After you have rested a bit, give Jenkins a hand on it."

The apprentice climbed up in the cab but not to take a nap as Evans had expected. He sat down on the sand box and with his inevitable piece of soapstone began figuring on the lid. The figures substantiated his original opinion that a five-horsepower motor wouldn't have sufficient power to slide a heavy pair of main drivers very rapidly and would require considerable gearing down to move them at all.

Interested in the problem, Anderson soon forgot being sleepy. After he had worked on it some time, he took a piece of waste and erased the figures on the sand box lid, climbed down from the cab and went to the machine shop where Jenkins was working on the winch.

The machinist had gotten a small drum for a cable from some place. Evidently a small hoist, the drum was mounted on a substantial frame. The machinist had several gears and was building a gear box when the apprentice went it.

"How fast is the drum going to turn?" Anderson asked Jenkins.

"Oh, I don't know exactly. The motor runs 1760 revolutions a minute, but I'm going to gear it down a lot."

"Do you think a five-horsepower motor will pull it?" Anderson eyed the gears that were laid out on the bench as he spoke.

"Figure it ought to," Jenkins replied. "The motor on the overhead crane hoist is only 15 horsepower and it will lift over ten tons."

"Lifts pretty slow," the apprentice observed. "Can I help you?"

"Yeah, find the electrician and tell him I'll be ready to try this thing out this afternoon if he can get the motor on it."

Next morning the winch was fastened securely to a post on the side of the drop-pit opposite the machine shop. The cable was hooked to a pair of drivers and the motor started. Swish!—Ooomph! Swish was the sound the cable made as it was rapidly jerked taut by the revolving drum—oomph represents the last sound the motor made before a blown fuse relieved the strain. The pair of drivers just stood there as though nothing had happened.

"Looks like it runs too fast," Jenkins remarked.

"Looks like too much load for the motor," the electrician said.

"Looks like you are both right," Evans observed. "What do you think about it, kid?" The foreman turned to young Anderson who was watching without saying anything.

"Yes," the apprentice agreed, "it needs a larger motor and the speed reduced."

"I can change this five-horse motor for the ten on the cut-off saw in the mill room," the electrician said.

"I don't see how we can reduce the speed any more," Jenkins said. "There is not room for any more gears."

"Wouldn't a small V-belt pulley on the motor and a large one on the gear shaft do it?" the apprentice suggested.

"I believe it would," Evans said. "It's worth trying." After the larger motor was put on with five-to-one V-belt pulleys, the winch did the job, and it's still going.

A little over a year after the apprentice started to work, a trade-extension evening class was started in the high school. All three apprentices enrolled as students. The class was in mathematics. The instructor, a machinist that had once taught school, invited all of the supervisors and officials of the mechanical department to visit the class whenever they had an opportunity. Evidently none of them ever had an opportunity, because none of them ever visited the class.

Anderson had not entirely finished the correspondence course he was taking, but the evening class required little more time than the two nights a week he attended. Bailey couldn't keep up with the rest of the class and gave up after two weeks of it. Caldwell decided he could learn more rapidly just studying the book without attending the class. At least that was the reason he gave for quitting the third week.

After two years at Plainville, the apprentices were sent to a back-shop to get experience there. Just before the four years were completed, they came back to Plainville, worked a short time, and received certificates stating that they were full fledged machinists. As each one completed his apprenticeship, he worked one day as a machinist to establish seniority. Bailey was cut off first and was oldest of the three in machinist seniority. Anderson was the youngest.

Bailey had heard that there were jobs to be had in the Texas oil fields and spent several months thumbing his way around. Caldwell got a job working in his Uncle's filling station. Anderson worked extra in a contract machine shop until they found they could use him regularly.

When the government decided that a few more guns might be needed, Anderson was one of the first to apply for a job making them. Caldwell tried it too at several places and didn't like any of them. Bailey didn't like the job he got in a shipyard and he never will like any mechanical job. Added to that is the constant fear of getting fired because he can't do the work. He returned to the railroad because he thought there would be less chance of his losing a job. The only good machinist of the three is unlikely to work for the S. P. & W. again.

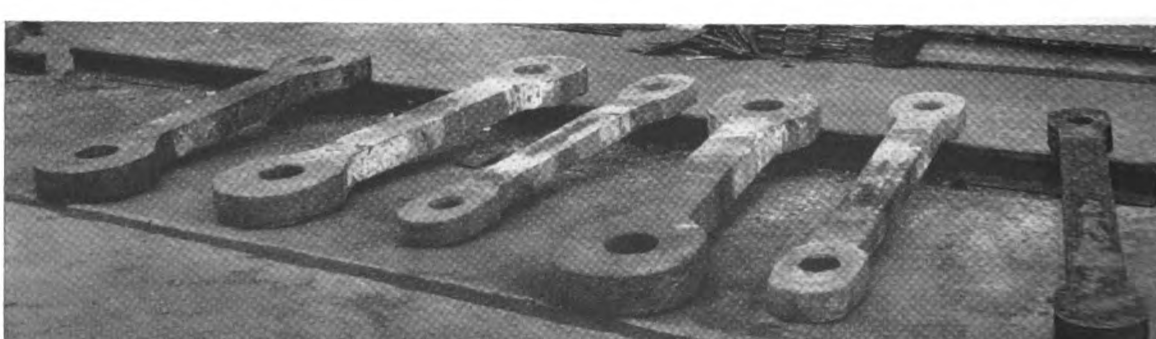
Three more apprentices are being put on at Plainville. Chances are young Wilson will be one. His dad is road foreman and a good mechanic. Maybe four years on the railroad will overcome the boy's tendency to draw pictures which he does exceptionally well. Young Elliott has been a good hand in a grocery store. Maybe he will be a good mechanic, and there's young Dillon. His dad hopes a job on the railroad will curb his tendency to ramble around over the country. Young Dillon won first prize in the state oratorical contest in his senior year of high school. It might be a good idea for him to stay in practice. He may need it to talk some one into giving him a job four years from now.

Drawbar-Shortening Machine

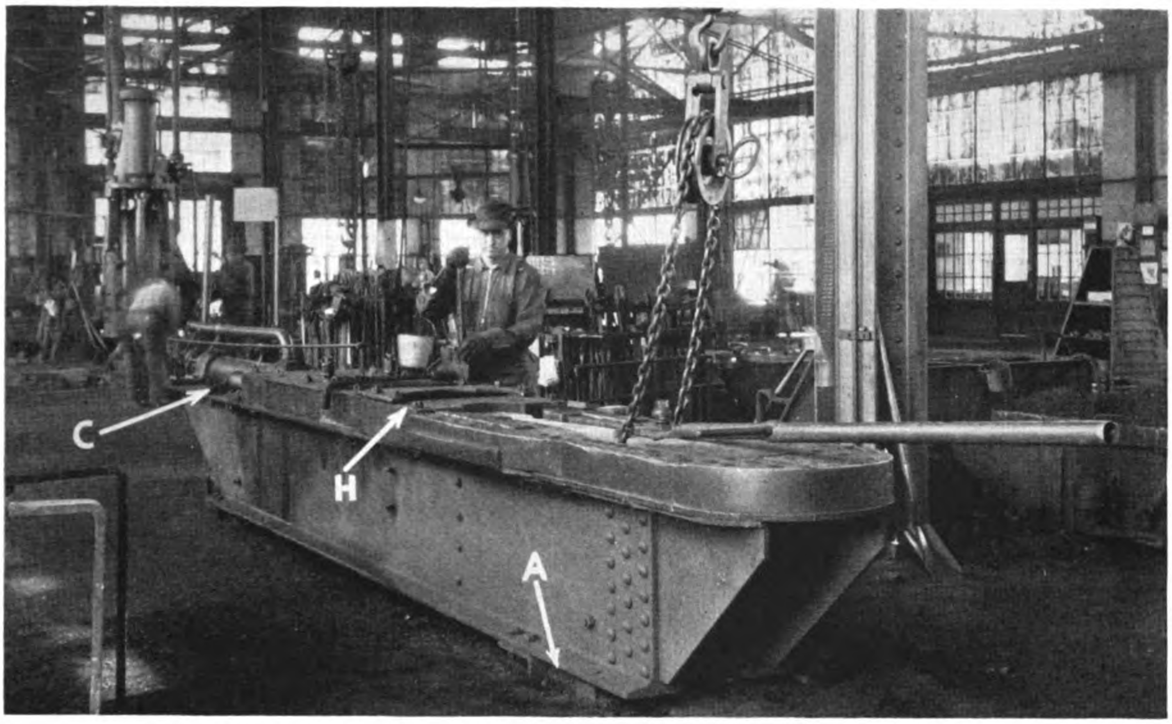
The drawbar-shortening machine, shown in one of the illustrations, is now being used at the Atchison, Topeka & Santa Fe shops, San Bernardino, Cal. The machine will take drawbars varying in length from 58 in. to 97 in., and the character, as well as wide range of work handled, is indicated by the second view showing six short drawbars resting on a concrete storage platform just outside the blacksmith shop building.

In view of the relatively heavy forging operation which must be performed and the severe stresses introduced by hammer blows, the drawbar-shortening machine is made exceptionally rugged in construction and mounted on a substantial foundation which consists of four locomotive guides set vertically in large cement blocks in the shop floor. The frame of the machine is made of two 30-in. steel I-beams, 22 ft. long, spaced 26 in. apart and anchored to the supporting guides in the floor by means of four angle brackets with 2-in bolted coil-spring connection to the guides as shown at *A*. This construction cushions the shock at each hammer blow by allowing the machine to move backward slightly at the moment of impact. Experience has shown that it is almost impossible to maintain this type of forging machine permanently fixed to a rigid foundation without some such method of cushioning the hammer blow.

Referring to the illustration which shows the drawbar-shortening machine, the general construction will be readily apparent. On the nearer, or right-hand end, a slotted header forging is riveted to the top of the I-beams with a sufficient number of closely spaced ⅞-in. rivets



Drawbars of different kinds and sizes which have been repaired and reclaimed by the use of the drawbar shortening machine



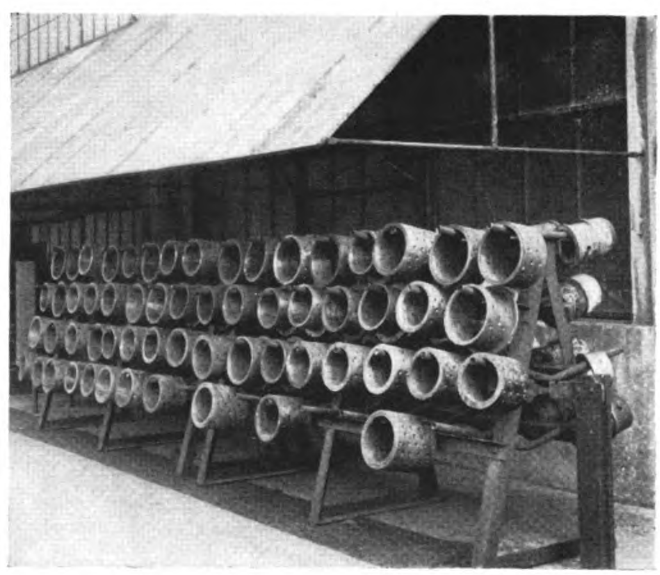
Drawbar shortening machine which is used at the Santa Fe shops, San Bernardino, Calif.

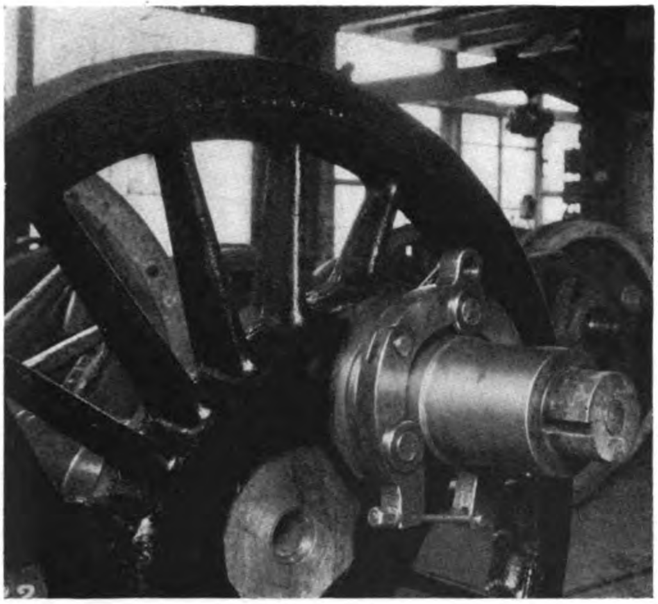
to make the forging an integral part of the machine. This substantial forging forms a solid stop for the cold end of the drawbar, which is supported on suitable cross-bars. Near the center of the machine is a sliding header die which either forms or upsets the heated end of the drawbar when struck by a heavy pneumatic hammer operating in a horizontal direction. This die block, which measures 20 in. wide by 15½ in. long by 6 in. thick, slides on two ⅜-in. by 3-in. steel liners, suitably lubricated from oil cups. The hammer which strikes this die block is connected to the outer end of a piston rod and piston moving in the 6-in. by 6-ft. long air cylinder *C*, shown at the left end of the machine. This piston with the attached hammer is operated by air under the control of a conveniently located three-way valve to deliver two or three heavy blows in quick succession, or more if necessary in upsetting large drawbars. The pneumatic hammer strikes the die and not the drawbar. Filler blanks give adjustment for both varying drawbar lengths and side widths.

This machine is used primarily for reforming drawbar heads in the case of elongated holes, and when not enough stock remains to do this a patch is sometimes welded on the end of the drawbar and the head completely reformed and brought back to standard. In welding, the first few seconds after the drawbar is removed from the fire are of the utmost importance and the arrangement shown in the illustration facilitates the necessary quick handling. The drawbar is trammed cold and the machine set with filler blocks of the correct length and width so that everything is in readiness for the weld. When a welding temperature has been reached, the drawbar is quickly transferred to the machine by means of the long handle extension bolted to the cold end the usual chain suspension from a jib crane. The necessary preliminary hammer blows may then be struck while the steel is still at a welding temperature. The drawbar is usually put back in the fire and reheated for a second working in the machine and some work is necessary under a steam hammer for straightening the head, removing burr and driving a steel pin through to size the hole. This drawbar-shortening machine is accurate to within about ⅛ in. and may be used in welding and reforming both heads for a large drawbar in approximately 5 hr. time, or 3 hr. less than would be required by the use of a steam hammer alone.

Rod Bushing Rack

A neat and convenient rack for storing second-hand rod bushings where they can be readily examined and calipered for size, is shown in the illustration. It is at the


Locomotive rod-bushing rack which provides neat storage and ready accessibility for calipering



Husky three-bearing roller used in rolling all crank pins after being turned at San Bernardino shops of the Santa Fe

San Bernardino, Cal., shops of the Atchison, Topeka & Santa Fe. This rack is approximately 18 ft. long, and is made in two sections, each 9 ft. long by 5 ft. high by 3 ft. wide at the base. The rack is made of welded 3-in. angle sections with 1-in. transverse pipe sections set in at regular intervals to support the bushings. The total capacity, including both sides of the rack, is 128 large bushings, although this capacity may be increased in the case of small bushings which are sometimes doubled up on the pipe holders, as shown at the back in the illustration.

In Santa Fe practice no second-hand bushings are used other than those which will bore and turn to accurate size for the position in which they are applied. Crank pins, however, are turned to 1/4 in. under size and steel bushings ground to 1/4 in. oversize. Consequently, bushings applied just before the wear limits are reached have some extra thickness which may be machined off in fitting the bushings to new crank pins and new steel bushings.

Locomotive Boiler Questions and Answers

By George M. Davies

(This department is for the help of those who desire assistance on locomotive boiler problems. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless special permission is given to do so. Our readers in the boiler shop are invited to submit their problems for solution.)

Relieving Boiler Stresses Caused By Welding

Q.—Should welding on locomotive boilers be stress relieved.—J. M. F.

A.—It is not the general practice to stress relieve welding on locomotive boilers due to the fact that welding on locomotive boilers is practically limited to that part of the boiler where the strength of the boiler is not dependent upon the strength of the weld. When welding on locomotive boilers, care should be taken to keep to a minimum the stresses set up in the sheets due to the welding process. There are several ways of doing this.

Peening is an effective method of reducing stresses and of partly correcting distortion or warping. Step-back welding will reduce locked-up stresses and warping due to the more uniform distribution of heat and the greater rigidity of the seam during the welding process.

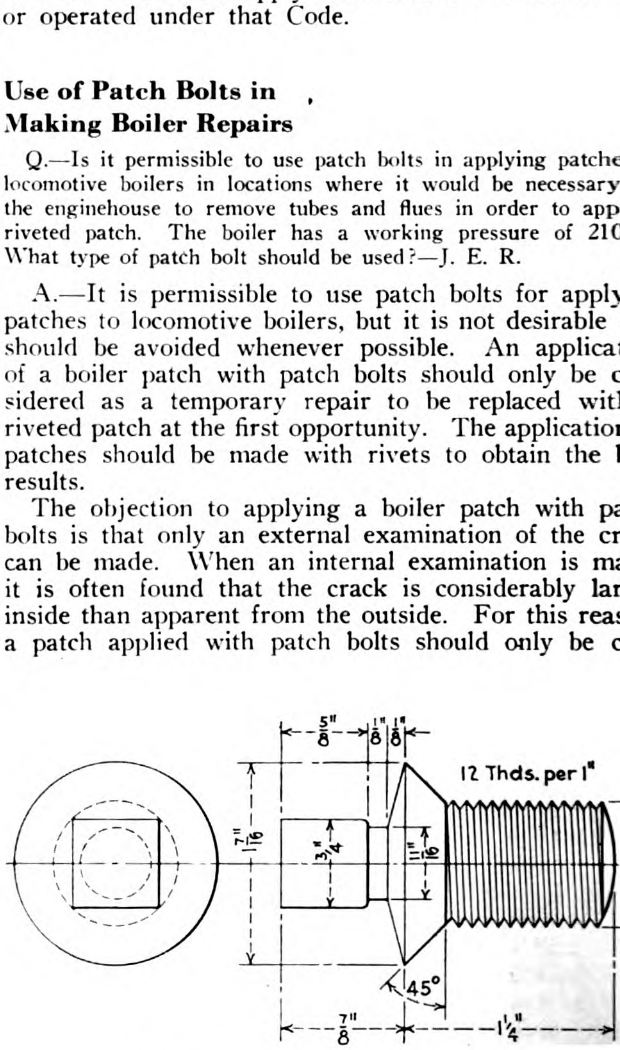
The A. S. M. E. code requires that all pressure vessels built in conformance to the code shall be stress relieved. This would apply to all locomotive boilers built or operated under that Code.

Use of Patch Bolts in Making Boiler Repairs

Q.—Is it permissible to use patch bolts in applying patches to locomotive boilers in locations where it would be necessary for the enginehouse to remove tubes and flues in order to apply a riveted patch. The boiler has a working pressure of 210 lb. What type of patch bolt should be used?—J. E. R.

A.—It is permissible to use patch bolts for applying patches to locomotive boilers, but it is not desirable and should be avoided whenever possible. An application of a boiler patch with patch bolts should only be considered as a temporary repair to be replaced with a riveted patch at the first opportunity. The application of patches should be made with rivets to obtain the best results.

The objection to applying a boiler patch with patch bolts is that only an external examination of the crack can be made. When an internal examination is made, it is often found that the crack is considerably larger inside than apparent from the outside. For this reason, a patch applied with patch bolts should only be considered as a temporary repair and should be renewed with a riveted patch at the first opportunity so that a complete examination of the crack can be made.



Typical patch bolt for applying boiler patch

Another objection to the use of patch bolts is that it becomes necessary to ream out the holes and apply oversize rivets when they are removed, thus affecting the efficiency of the patch. A typical patch bolt is shown in the illustration.

Wood Fuel for Locomotives.—Swedish State Railways will equip steam locomotives for burning wood fuel in view of the necessity of reducing coal consumption in the country during the unsettled conditions in Europe.

The Milwaukee Road

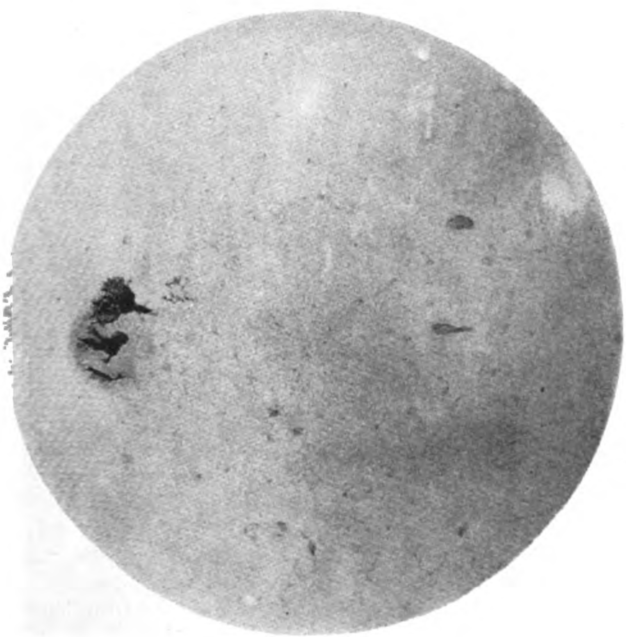
Reclaims Car Axles

By J. W. Crossett* and G. Ireland†

Out of 246 axles inspected in two years, 154, or 62.6 per cent have been reforged and heat-treated for use as roller-bearing axles

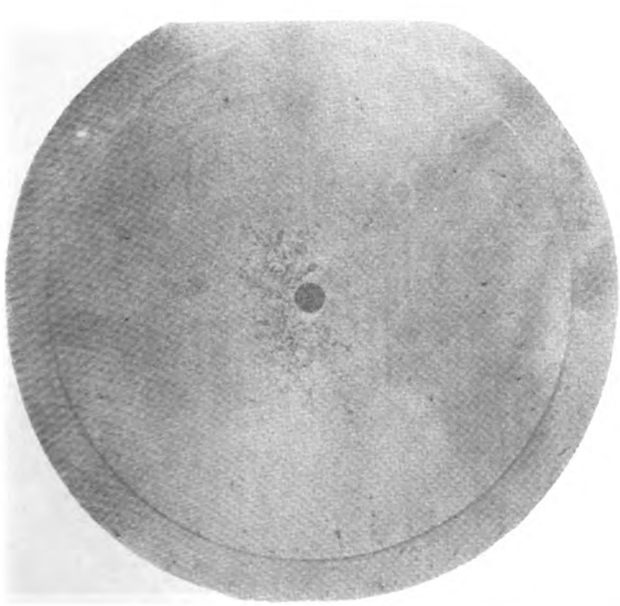
THE Chicago, Milwaukee, St. Paul & Pacific, like many other Class I railroads, found themselves possessing a preponderance of friction-bearing car axles, which had to be stored, inventoried and re-inventoried, and a perpetual shortage of roller-bearing axles which were continually being purchased. In order to remedy this condition a reclamation program was initiated wherein the older freight and passenger friction type axles of the 5½-in. by 10-in. size were reforged to make roller-bearing axles.

* Assistant metallurgist, C. M. St. P. & P.
† Forge shop supervisor, C. M. St. P. & P.



Experience in investigating failures of axles of this older type warned against promiscuous selection for reforging as the journals are liable to be heat checked and some of the axles were forged from low quality steel. The heat checks do not present a major problem as they either open up during forging or are found when the completely machined axle is examined by the Magnaflux method. This lack of quality in the steel, found by etching in hot dilute hydrochloric acid, as shown in Fig. 1, is due either to poor forging technique or mill practice. Axles of this quality are satisfactory for freight or slower passenger service where the factor of safety is exceedingly high but would not prove satisfactory under the modern high-speed streamliners where excess weight is held to a minimum and the factor of safety is more rational.

To make certain that none of these inferior quality axles were used for reclamation, a method of testing was developed in which one end was sawed off each axle, both parts identified with a serial number, and the small slab turned over to the Milwaukee test department. At



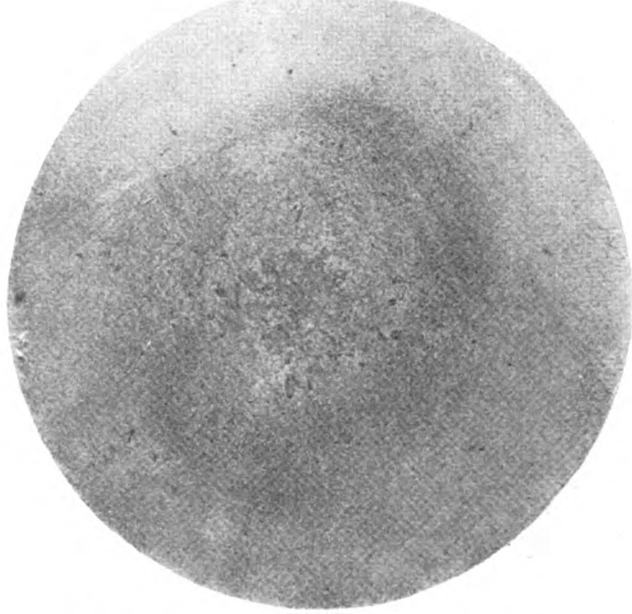


Fig. 1—Etched sections show unsatisfactory quality in some of the car axles found unsuitable for reforging

the beginning of this program two years ago, it was felt that a complete chemical analysis, microscopic examination and a deep etching were necessary but after completely analyzing 25 ends is was found that the manganese, phosphorus and sulphur contents were satisfactory, and to save time only a carbon determination was run on the next 70 axles. Inasmuch as the carbon content of these 70 axles fell within the range fo the A. A. R. Specification M-101-39, or .40 to .55, it was felt that this was also unnecessary. A microscopic examination was also made on the first 25 axles, but as the majority were uniformly coarse grained, 90 per cent being classified as McQuaid-Ehn No. 1, and showed a Widmanstatten structure indicating unsatisfactory heat treatment, or none at all, this was also discontinued. Some typical micro-photographs are shown in Fig. 2.

After the test department completed their work, the axles were marked as being either satisfactory for reclamation or scrapped. When enough good axles were on hand to provide a full day's work for a hammer crew they were reforged. This reforging was done by two methods in our shops. The first, the more obvious one, consisted of taking an axle as shown in Fig. 3, previously sawed off at *AA* for test purposes, and drawing out the two tapered sections *BB*. This method had two disadvantages; the axles had to be drawn out one end at a time, necessitating two heats on each axle. It is difficult to reforge an axle in this manner and keep it straight. To overcome these disadvantages, a jig, shown in Fig. 4, was fabricated by welding from unmachined sections cut on the oxygraph machine. To reforge an axle in this jig, the axle is cut off just behind the coller at *C* and this end heated for forging. When a forging heat is reached the sawed end is placed in the hollow of the die *A* and held in place by supports *B* and *C*. The mating wedge *D* to the wedge welded on the back of the die *A* is put in place and the hammer forces it down, which, in turn, shortens and thickens the journal section.

Table I—Typical Chemical Composition of Untreated Car Axle

	Per cent
Carbon	0.48
Manganese	0.61
Phosphorus	0.010
Sulphur	0.034

Table II—Physical Properties of Car-Axle Test Specimens, Untreated and Heat Treated

	As received	Quenched and tempered
Yield point, lbs. per sq. in.	40,200	63,600
Tensile strength, lb. per sq. in.	77,500	98,400
Elongation in 2 in., per cent	25.0	21.0
Reduction in area, per cent	35.3	47.5

Table III—Normal Chemical Composition of a Car Axle Reforged by Improved Method

	Per cent
Carbon	0.52
Manganese	0.38
Phosphorus	0.050
Sulphur	0.047

Table IV—Physical Properties of Test Specimens Taken from a Reforged Axle

	End	Center
Yield point, lb. per sq. in.	55,200	51,200
Tensile strength, lb. per sq. in.	88,900	93,600
Elongation in 2 in., per cent	30.0	26.0
Reduction in area, per cent	51.4	45.0

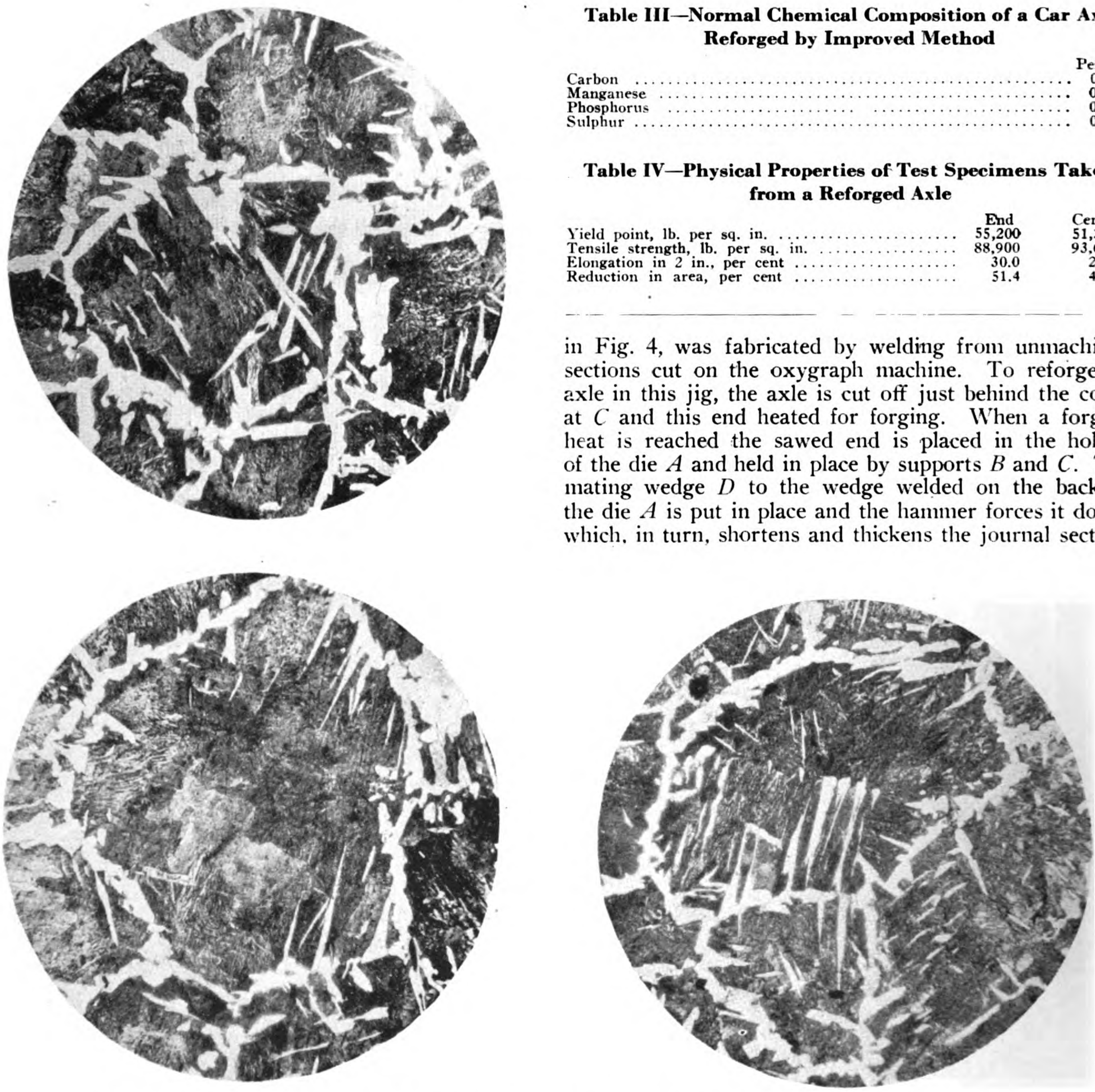


Fig. 2—Typical microphotographs showing coarse grain structure of car axles before being heat treated

By this method the daily output is increased and a straighter axle is obtained.

It is obvious that the low initial physical properties of the steel are not improved by heating for this reforging process. In order to determine what improvement could be expected by heat treating these axles, one of the ends that had been sawed off at point *A* for test purposes was split in half parallel to the length of the axle. These two halves had the typical chemical composition, shown in Table I. One of these sections was left as received and the other oil quenched and tempered. A standard .505-in. tensile bar was taken from each section and the physical properties obtained from these bars are shown in Table II. The yield point, which is the value most design calculations are based on, was improved 50 per cent and the tensile strength raised over 27 per cent. The elongation was reduced slightly but this loss was compensated for by the gain in reduction in area. These changes are readily understandable from the microstructure of the two pieces shown in Fig. 5. The coarse-grained Widmanstatten structure, typical of the as-received axles, was converted to a fine-grained sorbitic structure insuring a maximum degree of toughness and fatigue resistance.

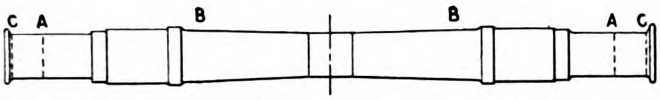


Fig. 3—General design and proportions of the scrap car axle before being reclaimed

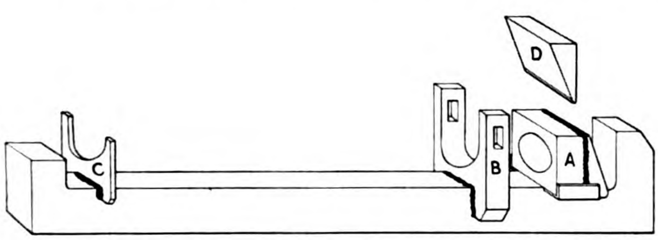


Fig. 4—Special jig used in upsetting heated car axle end under a steam hammer

These axles at present are being oil quenched from 1,525 deg. F. and drawn for three hours at 1,100 deg. F. After heat treatment they were sawed to length and turned over to the machine shop for final processing. A remarkable improvement in machinability was found to have been brought about by the heat treatment, which increased the hardness from about 120 to 185 Brinell hardness and changed the structure from pearlite to sorbite.

One of the axles which had been reforged by the newer method was taken for metallurgical investigation to determine what was actually being obtained. A microscopic examination of a section cut through the upset journal showed the flow lines formed by this method to be satisfactory, there being no abrupt changes, folds or cross flows.

Two tensile bars were obtained from the axle which had the normal chemical composition of Table III, both being parallel to the length, one taken midway between the center and the surface of the upset end and the other at the intersection of the longitudinal and transverse center lines. These results shown in Table IV are not as good as those obtained by treating the small end section but are still much better than found in the original axles. The microstructure of the heat-treated axles indicate a lack of complete refinement which condition could probably be overcome by normalizing before quenching.

Since the initial program was begun two years ago, 246 axles have been inspected and 154 or 62.6 per cent have been found to be suitable for reclamation. This percentage could have been increased, but safety was the prime consideration and there was tendency to lean backward and scrap axles with the slightest amount of unsoundness. The axles marked as being unfit for reclamation were initially scrapped, but with the present steel shortage they are hammered down to make parts such as coupler bolts and wrist-pin washers where the stresses are not high. When this reclamation program was begun the chief desire was to cut down the inventories and use up some of the older axles but under the present defense program with the steel shortage and priority number it becomes almost imperative to continue reclaiming the older axles to meet the normal replacement demands.

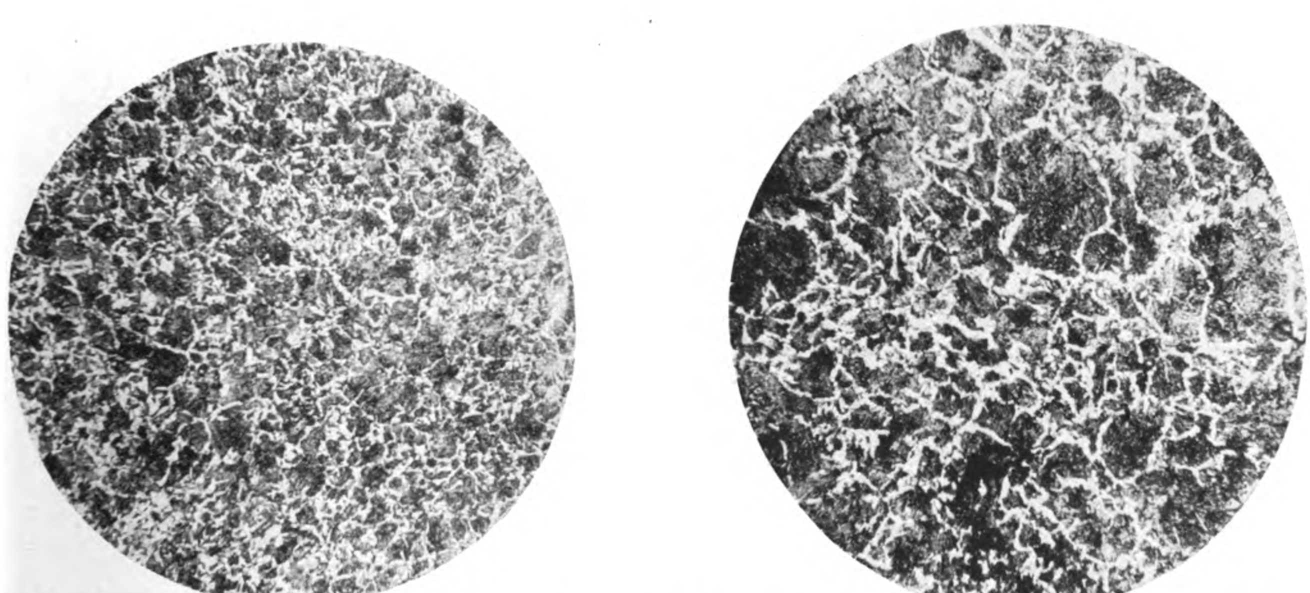


Fig. 5—Microphotographs of reforged car axles which have been tempered and quenched. (Left) Center test bar. (Right) End test bar

Air Brake Questions and Answers

AB-8, Empty and Load Equipment*

1—*Q.—For what is the AB-8 Empty and Load Brake supplied?* A.—For light weight cars having a high load capacity.

2—*Q.—Does the AB brake not answer the requirements in this respect?* A.—The AB brake is a single-capacity brake, developing a constant braking force whether the car is empty or loaded. This brake develops a braking force equivalent to 60 per cent of the empty car weight, based on 50 lb. pressure in one 10-inch brake cylinder and is used on cars having an empty weight of 58,000 lb. or less, and a carrying capacity of less than three times the empty car weight.

3—*Q.—How does an increasing load affect retarding force?* A.—As the load increases, the retarding force is less effective with the single-capacity brake.

4—*Q.—Why will a constant braking force fail to produce effective braking in all cases?* A.—On light-weight cars having a high load capacity the spread between light and loaded weight is so wide that a constant braking force will not produce effective braking under both extremes. A high constant value for effective load braking is excessive for empty braking and a low value for empty braking is inadequate for load braking. There is either too much empty brake force or too little load brake force.

5—*Q.—On what type car is the AB-8 Empty and Load brake generally applied?* A.—Gondola or hopper cars used principally in coal or ore service, where they generally operate either empty or fully loaded.

6—*Q.—What braking ratio does the AB-8 Empty and Load Brake provide?* A.—Sixty per cent of the car's weight when empty and generally about 30 per cent of the maximum loaded weight (which can be made to suit local conditions) based on a brake cylinder pressure of 50 lb. per sq. in.

7—*Q.—How does this brake differ from the standard AB brake?* A.—Functionally, there is no difference, the basic AB equipment being used with the addition of supplementary apparatus embodying the function of a double-capacity brake. Thus the basic AB brake is retained so that the interchange characteristics are unaffected.

8—*Q.—What does the supplementary apparatus represent?* A.—A minimum addition to accomplish the purpose of the load brake consisting only of a load cylinder and change-over apparatus.

9—*Q.—What does the change-over apparatus consist of?* A.—A change-over valve and a strut cylinder.

10—*Q.—How is the change-over function accomplished?* A.—It is fully automatic, changing when the load is changed, and the brake-pipe pressure is restored after being depleted.

11—*Q.—What additional air consumption is involved with this brake?* A.—None. Standard AB reservoirs are used for volume.

12—*Q.—Are additional lever members required?* A.—On some installations the location and arrangement of the brake cylinders is such that no additional levers are required. On other installations, due to space limitations, one additional lever is required.

13—*Q.—What are the parts of a complete set of AB-Empty and Load equipment.* A.—One ABEL-1 valve, Fig. 3; one AB-1 change-over valve, Fig. 7; one 8-in. by 8-in. or 10-in. by 10-in. load brake cylinder, Figs. 1 and 15; one 8-in. by 12-in. empty brake cylinder, Figs. 2 and 14; one strut cylinder and bracket, Fig. 9; one truck bolster bracket, Fig. 12; one car bolster bracket, Fig. 13; two ½-in. hose with reinforced fittings; one combined auxiliary and emergency reservoir; two 1¼-in. angle cocks; two 1⅜-in. hose with couplings; one pressure retaining valve; one combined dirt collector and cut-out cock and one branch-pipe tee.

* This is a new series of questions and answers which supplements and brings up to date the original series on the AB equipment which appeared in *Railway Mechanical Engineer* from April 1936 to March, 1939. As in previous series references to figure and part numbers are to the manufacturers' instruction pamphlets.

Decisions of Arbitration Cases

(The Arbitration Committee of the A. A. R. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Car Damaged Due to Impact Switching—Handling Line Responsible

On October 11, 1939, at Dayton, Ohio, a Baltimore & Ohio locomotive moved a cut of 40 cars into a track on which 55 cars were standing. In making the coupling, Mississippi Central steel-center flat car No. 2114, the second car in the standing cut, failed, resulting in damage to the center, intermediate and side sills. Disposition was requested under A. A. R. Rule 120, owner's responsibility. The Mississippi Central would not agree to recognize the settlement of this case as coming under A. A. R. Rule 120 as in its opinion and interpretation of Rule 32 it was a handling line responsibility and it insisted on settlement being made under Rule 12. The B. & O. stated that there was no other damage to any car and furthermore the 55 cars standing on the track had been inspected prior to the coupling of the 40 cars and no exceptions had been taken. The B. & O. thought that the handling of this car should not come under impact switching as it is an operation that takes place very frequently where trains are doubled from one track to another to get sufficient tonnage before leaving a terminal. It claimed that had this damage occurred when a car or a cut of cars had been switched in, or shoved over a hump, and improperly controlled, the damage would have been given proper consideration. As there was no derailment or other Rule 32 condition involved, the B. & O. believed the damage to be car owner's responsibility. The Mississippi Central understood that Paragraph (d), Section (10) of A. A. R. Rule 32 establishes a specific dividing line as to the responsibility for damages resulting from impact switching. It stated that the B. & O. acknowledged that this car was damaged to the extent shown in Rule 44 and as there were six sills broken and two center sills bent, the Mississippi Central considered that the accident was caused by coupling a moving cut of cars to a standing cut at a speed exceeding the limits of safety. It contended, in view of the facts, that the B. & O. should be held responsible for the full amount of the damage.

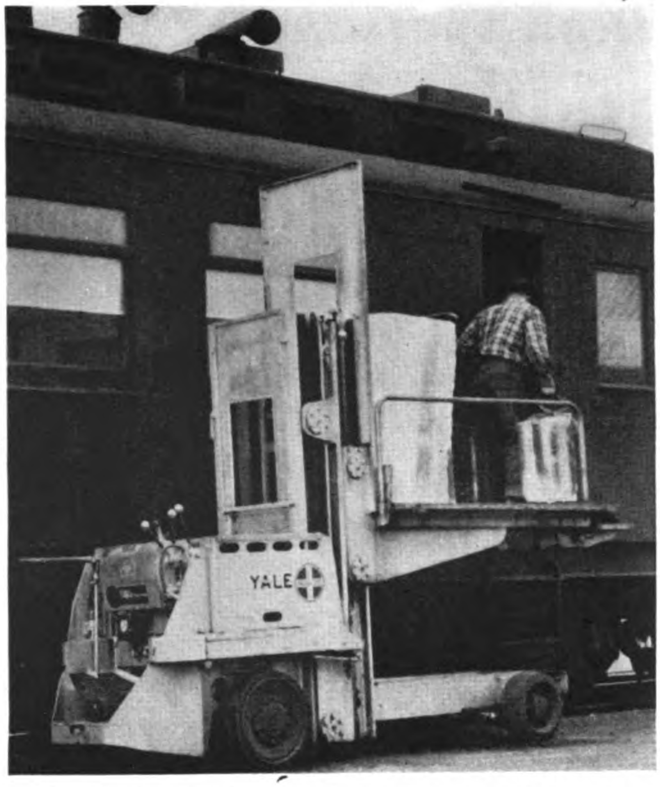
In a decision rendered November 14, 1940, the Arbitration Committee stated: "This car having been damaged in switching to the extent specified in Rule 44, the handling line is responsible under the provisions of Rule 32, Section (10), Paragraph (d)."—*Case No. 1779, Baltimore & Ohio versus Mississippi Central.*

High-Lift Truck for Icing Passenger Cars

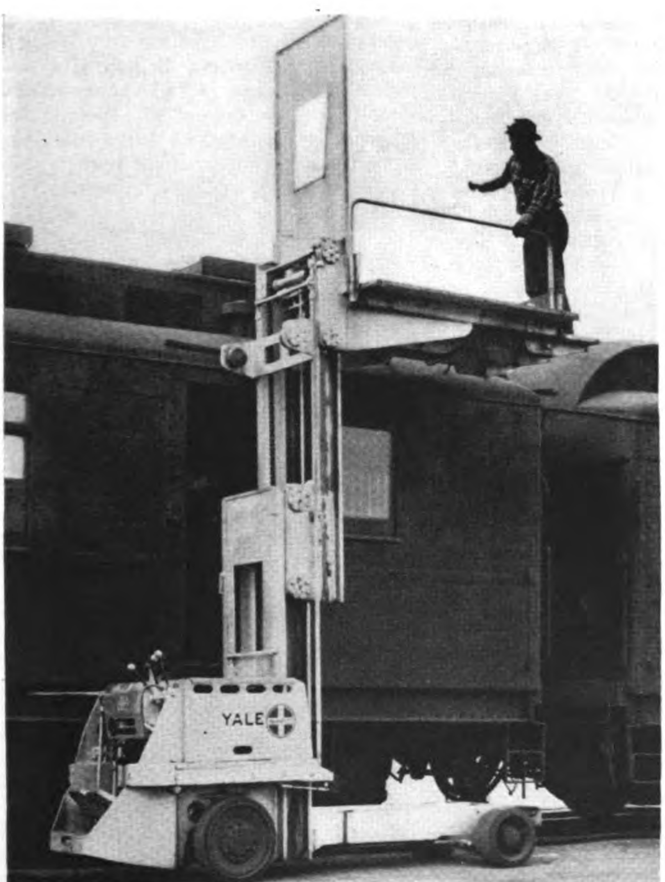
Railway passenger cars, particularly dining cars on long runs, require the replenishment of their supply of ice at intermediate station stops. The ice is carried in bunkers located in the roofs of the cars and each car usually has from two to four bunkers varying in capacity from 300 to 900 lb. per bunker. Also, a supply of ice is carried in the dining-car kitchen at floor level.

The usual practice in icing such cars is to haul the ice in full cakes of 300 lb. each on a baggage truck alongside the car, one man on the truck breaking the ice into about 10-lb. pieces and tossing them to a man on the car roofs who drops them into the bunkers. This method is slow and there is also a risk of ice chunks falling upon near-by passengers, or possibly breaking car windows.

To reduce the time of icing cars and also lessen the possibility of personal injuries, electric lift trucks of special construction have been introduced, the one illustrated being used at the Albuquerque, N. M., passenger station of the Atchison, Topeka & Santa Fe. It consists of a Yale & Towne 4,000-lb. telescopic electric storage-battery truck with remote control from the loading platform for raising and lowering. This platform is 38 in. wide by 66 in. long by 16 in. high in the low position. It has a maximum height in the fully-raised position of 42 in. The truck platform is equipped with a folding catwalk and removable safety handrail on each side. The overall dimensions of the truck are 148 in. long by 56 in. wide by 95 in. high in the collapsed position. It has 20-in. by 5-in. drive wheels and 15-in. by 7-in. trailer wheels, spaced 80 in. on centers. When loaded with ice, the platform will support nine cakes, or about 2,700 lb.



Electric storage-battery-operated truck with icing platform at intermediate level



Yale & Towne high-lift electric truck used in icing Santa Fe passenger cars at Albuquerque, N. M.

This truck is employed in the icing of four Santa Fe daily trains and five semi-weekly trains, also certain refrigerator express cars. Each train has from one to three cars requiring icing. The average amount of ice supplied to each train is about one ton, and the number of times the platform is lifted and run down and lifted again varies from three to five for each car iced. The platform is raised to its high position in 44 sec., and lowered in 22 sec. The platform is lowered each time the truck is moved to another location.

The use of this truck has resulted in the saving of eight man-hours on each of the two shifts where the truck is used. It has also reduced the time and cost of moving ice from the ice house, which formerly took about an hour, with two or three men to push the baggage truck. By means of the electric truck, one man can make the run in about 15 min. The use of this truck for icing express cars has saved taking these cars from the train to the ice house. Specific figures on the amount of this saving are not available.

Ice for Pullman and coach car fountains is obtained by porters from small ice carts, about 3 ft. by 5 ft. in size, drawn along the platform by hand and not served by the icing truck.

By use of this high-lift, electric icing truck the force icing cars has been reduced and more time is available for the remaining men to clean or otherwise service the lay-over equipment in the yards.

High Spots in
Railway Affairs . . .

Railways Handle Grain Crop Successfully

The Car Service Division of the A. A. R. took even more than the usual precautions to make sure that the railroads would handle the wheat crop promptly. The problem was complicated by the fact that they first had to move about 40,000,000 bushels of the stored 1940 crop. They not only did this, but handled promptly all of the 1941 wheat for which storage space could be found. The problem developed into one not of transportation, but almost entirely of storage. The Commodities Credit Corporation has had a difficult time attempting to correct the storage situation, and apparently fell down badly on its assignment.

Transportation Of Armed Forces

National defense activities have made a heavy demand upon railroad passenger facilities in recent months. This additional load, however, has not interefered with the regular freight and passenger services. The total number of the nation's armed forces moved by the railroads in the first half of 1941 was 1,452,303. This included the armed forces of the Army, Navy, Marines and selectees, as well as members of the Civilian Conservation Corps. Of this number 859,230 were handled on 2,861 special trains. The remainder, including 503,425 selectees, were handled on regular trains, the selectees for the most part being moved from induction stations to reception centers.

Panama Canal Traffic Goes to Railroads

Because of the extensive transfer of American ships to British service, intercoastal traffic through the Panama Canal has been considerably diminished and much transcontinental business has been transferred to the railroads. The effect of the transfer and sale of ships first became noticeable in the summer of 1940. The Southern Pacific traffic, measured in ton-miles during 1940, was the largest in the company's history. In 1940 it handled more than 17,528,000,000 ton-miles of freight, as compared with its former high record of less than 16,500,000,000 in 1929 and 15,393,000,000 in 1939. Contrasted with this, all of the Class I railroads in 1940 handled only 81 per cent as much traffic as in 1939, and 75 per cent as much as in 1929. The Southern Pacific, Santa Fe, Northern Pacific and Union Pacific all showed a greatly increased average haul in 1940, as compared to previous years. Not only has the intercoastal traffic been diverted to the railroads, but they have also been called upon to handle other steamship tonnage at Pacific ports, formerly moved East by way of the Panama Canal.

I. C. C. Headquarters

The Interstate Commerce Commission has a splendid office building in Washington that is coveted by some of the other numerous bureaus that have been growing by leaps and bounds under defense activities. The suggestion has been made in Congress that in the proposed government decentralization it might be well to transfer the Interstate Commerce Commission to Chicago. This has stirred up considerable consternation among the large number of practitioners and others who have established residences in Washington. Southern interests, also, are very much averse to such a move. Interestingly, the I. C. C. Act specifically states that it should have its headquarters in Washington, and before its base can be shifted it will be necessary to enact new legislation. The opposition to the move is so great that it is extremely doubtful if such a change in the Act can secure the necessary votes.

The Steel Supply

Walter S. Tower, president of the American Iron & Steel Institute, in speaking before the purchases and stores officers at Chicago, emphasized the fact that there is ample steel production in this country to take care of our domestic civilian requirements. He cited the following to support his contention: "Available facts justify the belief that both this year and in 1942 there will be fully 67,000,000 tons of steel-making capacity which can be used for domestic civilian consumption and for whatever exports may seem desirable to countries other than Britain and Canada. Such other exports are not likely to call for more than 3,000,000 tons of ingots, leaving a minimum of 64,000,000 tons for domestic civilian uses. This country has never in any year been able to use any such quantity of steel. Even in 1940, total domestic consumption, including defense and civilian uses, was only 55,000,000 tons." He also directed attention to the fact that the Office of Price Administration and Civilian Supply has issued an order giving preference to materials for car building and repair over all other civilian uses.

Little Danger From Handling Explosives

The Bureau of Explosives, A. A. R., is greatly to be commended for its achievements over the years. Through a careful and persistent campaign of education and its staff of field work inspectors, steady progress has been made in reducing the number of accidents. Last year, 1940, a total of 818 accidents occurred, involving a property loss of $142,829, chargeable to accidents involving explosives and other dangerous articles. There were but three accidents in the transportation of explosives in Canada and the United States during the year; these included two slight explosions in the handling of toy torpedoes and one explosion in a freight house from blasting caps and dynamite awaiting removal by the consignee. Including all other dangerous articles under the jurisdiction of the Bureau, there were 68 fires, two deaths and 74 persons injured.

Transporting Oil To the East Coast

Harold L. Ickes, petroleum co-ordinator for national defense, gave the East a bad scare when he announced some time ago that the transfer of tankers to British shuttle service, coupled with the increasing consumption, might make it necessary to restrict the use of gasoline for motor cars and fuel oil for domestic heating during the coming months. As pointed out by J. J. Pelley, president of the Association of American Railroads, the railroads for many years have been a diminishing factor in the transportation of oil, since the oil companies have built up their own transportation systems of tank ships, barges, pipe lines and tank trucks. It appears that there are unused tank cars owned by private line companies that can be used for this purpose, although the transportation cost may be somewhat increased. Secretary Ickes in a statement late in June called upon the oil companies to give attention to the possibilities of the greater use of such tank cars.

NEWS

Compliance Section, OPM

A Compliance Section, headed by L. J. Martin, has recently been created to "control and supervise compliance cases arising through complaints from within OPM, from within the armed services, and from industry and the public."

A. C. L. Shop Forces On 48-Hr. Week

Shop forces of the Atlantic Coast Line were placed on a 48-hr. per week work basis effective the week of June 22. Prior to June 1, shopmen had been working, with minor exceptions, 40 hr. a week. On that date the work-week was lengthened to 44 hr., which, to further facilitate the road's program of repairing and returning to service all freight cars when age and condition justifies, has been prolonged to 48 hr., thereby increasing output 20 per cent.

Railroad Repairs Given Priority Status

Priority status for repair and maintenance materials for 26 industries including the railroads was assured during the week ended July 5 when the Civilian Supply Allocation Division of the Office of Price Administration and Civilian Supply promulgated an allocation program covering such items.

Action was necessitated, said the O. P. A. C. S. announcement, by growing demands on raw materials as result of the defense program and the priorities granted in connection therewith which have made it difficult for manufacturers of repair and maintenance materials and equipment to fill their orders. The effect will be to assure continued operation of essential industries and services which otherwise might have to curtail because of inability to secure needed repair or maintenance parts, the announcement concluded.

Plate Capacity for Car Materials To Be Increased

Capacity of wide strip steel mills to make light plates for railroad cars, ships and other purposes will be increased 754,000 tons to a total of 2,480,000 tons by the early part of 1942, according to the Office of Production Management. W. A. Hauck, OPM steel consultant, disclosed that outlook after visiting several strip mills and compiling results of a questionnaire submitted recently to the 13 mills rolling strip 54 in. or more wide.

Present total capacity of these mills is 12,941,400 tons, of which 1,726,000 is light plate capacity and 11,21,400 is for the manufacture of strip. Of the additional plate capacity to be provided, 654,000 tons will be obtained gradually by the end of this year and 100,000 will be available by March 1, 1942. The OPM announcement said that a regulation will be issued shortly to all steel companies with strip and plate capacity, requesting them to reallocate to strip mills plates now scheduled for the regular plate mills, in cases where the sizes and quantities are better suited for strip mill production. Meanwhile, additional heavier plate capacity is being installed by some of the companies that have strip mills, and more plate capacity is being provided also by companies not operating strip mills. Further additional capacity is proposed in the overall expansion of the steel industry now under consideration.

Orders and Inquiries for New Equipment Placed Since the Closing of the July Issue

Locomotive Orders

Road	No. of Locos.	Type of Loco.	Builder
Boston & Maine	2	44-ton Diesel-elec.	General Elec. Co.
Clinchfield	8	4-6-6-4	American Loco. Co.
Delaware & Hudson	15[1]	4-6-6-4	American Loco. Co.
Elgin, Joliet & Eastern	2	1,000-hp. Diesel-elec.	Baldwin Loco. Wks.
Florida East Coast	3[2]	2,000-hp. Diesel-elec.	Electro-Motive Corp.
Illinois Central	2[2]	4,000-hp. Diesel-elec.	Electro-Motive Corp.
Lehigh Valley	3	44-ton Diesel-elec.	General Elec. Co.
New York, Ontario & Western	5	44-ton Diesel-elec.	General Elec. Co.
New York, Susquehanna & Western	6	1,000-hp. Diesel-elec.	American Loco. Co.
Ohio & Morenci	1	35-ton Diesel-elec.	Davenport-Besler Corp.
St. Louis-San Francisco	15[3]	4-8-4	Baldwin Loco. Wks.
Seaboard Air Line	3	5,400-hp. Diesel-elec. frt.	
	2	2,000-hp. Diesel-elec. pass.	Electro-Motive Corp.
	2	1,000-hp. switchers	
	3	1,000-hp. switchers	Baldwin Loco. Wks.
	3	1,000-hp. switchers	American Loco. Co.
Southern	1	1,000-hp. Diesel-elec.	Baldwin Loco. Wks.
	1	660-hp. Diesel-elec.	
United States Army	2	70-ton Diesel-elec.	Vulcan Iron Wks.
United States Navy, Bureau of Supplies and Accounts	2	Diesel-elec. switch.	Vulcan Iron Wks.
United States Navy Dept.	1[4]	50-ton Diesel-elec. switch.	Atlas Car & Mfg. Co.
United States War Dept.	9	45-ton Diesel-elec. switch.	Davenport-Besler Corp.
Upper Merion & Plymouth	1	660-hp. Diesel-elec. switch.	Baldwin Loco. Wks.
Western Maryland	1	660-hp. Diesel-elec. switch.	Baldwin Loco. Wks.
Wheeling & Lake Erie	10	2-8-4	American Loco. Co.

Locomotive Inquiries

Road	No. of Locos.	Type of Loco.	Builder
Louisville & Nashville	14-21	2-8-4	....
National Rys. of Mexico	20	4-8-4	....
	6	2-6-6-2	....
	6	4-8-0	....
	8	2-8-0	....

Freight-Car Orders

Road	No. of Cars	Type of Car	Builder
Akron, Canton & Youngstown	100	50-ton hopper	Bethlehem Steel Co.
	30	70-ton gondolas	
Central of Georgia	150	50-ton auto.	American Car & Fdry. Co.
	50	50-ton box	Pull.-Std. Car Mfg. Co.
Central of New Jersey	1,000	70-ton gondola	Bethlehem Steel Co.
Chesapeake & Ohio	1,000	50-ton hopper	American Car & Fdry. Co.
	1,000	50-ton box	Pull.-Std. Car Mfg. Co.
Chicago, Rock Island & Pacific	200	Gondola	American Car & Fdry. Co.
Clinchfield	5	70-ton covered hopper	American Car & Fdry. Co.
	7	Cabooses	
Delaware, Lackawanna & Western	600	50-ton box	American Car & Fdry. Co.
	250	Gondola	
	400	50-ton box	Magor Car Corp.
Florida East Coast	30	Gondola	American Car & Fdry. Co.
	30	Hopper	
Litchfield & Madison	50	Hopper	Gen. Amer. Trans. Corp.
National Rys. of Mexico	1,000	50-ton box	Magor Car Corp.
New York, Chicago & St. Louis	900	Box	Gen. Amer. Trans. Corp.
	250	50-ton hopper	American Car & Fdry Co.
New York, New Haven & Hartford	50	Cabooses	Pull.-Std. Car Mfg. Co.
Norfolk & Western	25	70-ton gondola	Ralston Steel Car Co.
Reading	500[5]	70-ton gondola	Bethlehem Steel Co.
	50	Cement	Co. shops
St. Louis Southwestern	500[6]	Freight	Co. shops
Seaboard Air Line	500	50-ton box	Pull.-Std. Car Mfg. Co.
	100	50-ton flat	Greenville Steel Car Co.
	50	70-ton cement	Bethlehem Steel Co.
	100	70-ton hopper	
Southern Pacific	700	50-ton box	Pull.-Std. Car Mfg. Co.
	700	50-ton box	Pressed Steel Car Co.
	700	50-ton box	American Car & Fdry. Co.
	150	70-ton hopper	
	500	50-ton box	Mt. Vernon Car Mfg. Co.
	700	50-ton gondola	Bethlehem Steel Co.
	300	70-ton flat	Pacific Car & Fdry Co.
	200	12,000-gal. tank	Gen. Amer. Trans. Corp.
	50	8,000-gal. tank	
Union Pacific	2,500	Underframes	Mt. Vernon Car Mfg. Co.
United States Army	50	10,000-gal. tank	Gen. Amer. Trans. Corp.
United States Navy	2	70-ton flat	Haffner-Thrall Car Co.
	20	50-ton flat	
	2	100-ton flat	
	26	30-ton flat	
Wabash	100	70-ton gondola	Co. shops
Western Maryland	4	Depressed-center flat	Co. shops

(*Continued on next left-hand page*)

Freight-Car Inquiries

Road	No. of Cars	Type of Car	Builder
Missouri Pacific	1,000	Box	.....
	50	Flat	.....
	500	Hopper	.....
	50	Coal	.....
	250	Box	
	450	Coal	[7] .....
	50	Flat	
	100	Box	
	300	Coal	[8] .....
	50	Flat	
	100	Box	[9] .....
	150	Coal	

Passenger-Car Orders

Road	No. of Cars	Type of Car	Builder
Atchison, Topeka & Santa Fe	7	Storage-mail	Edw. G. Budd Mfg. Co.
	8	Dining	
	6	Club-lounge	
	16	Chair	
Florida East Coast	3	Coach	[10] Edw. G. Budd Mfg. Co.
	1	Observation	
	1	Dining	
	1	Passenger-baggage	
Illinois Central	2	Lounge	Co. shops
Pennsylvania	12[10]	Coach	Edw. G. Budd Mfg. Co.
Pullman Co.	170[11]	Sleeping	Pull.-Std. Car Mfg. Co

[1] For fast heavy freight service. Delivery expected middle or latter part of 1942. Estimated cost $3,250,000.

[2] For passenger service.

[3] Purchase authorized by the court, also the purchase of five 1,000-hp. Diesel-electric locomotives. Cost of 15 steam locomotives, $2,692,500; five Diesel-electric locomotives, $392,500.

[4] Cost, $26,398.

[5] Order not confirmed.

[6] Construction authorized by the district court; cost, $1,748,000.

[7] For Gulf Coast Lines.

[8] For International-Great Northern.

[9] For Missouri Illinois.

[10] To operate in conjunction with 16 Atlantic Coast Line cars reported in July issue for through passenger service from New York to Florida.

[11] For the following trains: *Overland Limited* (Southern Pacific-Union Pacific-Chicago & North Western)—78 cars, 60 containing 4 double bedrooms, 6 roomettes and 6 sections; and 18 with 2 drawingrooms, 4 compartments and 4 double bedrooms; *Panama Limited:* (Illinois Central)—20 cars, 12 with 4 double bedrooms, 6 roomettes, and 6 sections; 2 with 2 drawing-rooms, 4 compartments, and 4 double bedrooms; 2 with 18 roomettes; 2 with 3 double bedrooms, 1 compartment, 1 drawing-room, and a buffet-lounge; and 2 with 2 double bedrooms, 1 drawingroom, 2 compartments, and a lounge-observation; *Golden State Limited:* (Southern Pacific-Chicago, Rock Island & Pacific)—24 cars, 11 with 2 drawingrooms, 4 compartments, and 4 double bedrooms; and 13 with 4 double bedrooms, 6 roomettes, and 6 sections; *Chief* and *Super-Chief,* (Atchison, Topeka & Santa Fe)—12 cars, 4 with 2 drawingrooms, 4 compartments, and 4 double bedrooms; and 8 with 4 double bedrooms, 6 roomettes, and 6 sections. For general service on Santa Fe trains, there will also be 26 cars containing 4 double bedrooms, 6 roomettes, and 6 sections; and 6 with rooms and an observation-lounge. In addition, four cars of the new equipment will be assigned to the Missouri Pacific, each containing 4 double bedrooms, 6 roomettes and 6 sections. Practically all of the cars will be of high tensile, alloy steel, of the welded girder type and air-conditioned.

Car Building Lags Says Budd

More efficient use of existing railroad facilities holds the possibility of increasing, by 25 per cent, the carrying capacity of the railroads and of avoiding a transportation bottleneck that might occur during the expanding business of the emergency, Ralph Budd, transportation commissioner of the advisory commission to the Council of National Defense, told a meeting of directors of the American Short Line Railroad Association at Chicago on July 14. Maximum use of the transportation plant, he indicated, is particularly important in view of the fact that the car building and repair program has slowed down because there has been some difficulty in securing materials.

Orders for repair parts are not being filled promptly and stocks of repair parts are being depleted through inability of manufacturers to obtain material, he said. Car and locomotive builders, he continued, are not affected by material delays to the same extent as shops making repairs. He warned against delaying car and locomotive building, pointing out that car builders are already behind about 7,500 cars on their orders. At the rate of the present interruptions due to shortage of material, the railways may fall 20,000 cars short of the program set up for completion by October 1. Unless material is released for railway use, he said, the program will fall down worse in the future because, for the year ending October 1, 1942, the railways had hoped to add 120,000 cars to their ownership. When retirements are included, this would mean a 160,000 car program between October 1, 1941, and October 1, 1942.

"The problem of providing adequate transportation in such times as these," Mr. Budd said, "is one of joint interest and responsibility, and can be solved best by the cooperation of all parties [the users of cars as well as the carriers] who must share that responsibility."

Speaking of car utilization, Mr. Budd continued: "Increased speed while on the road is not so important as maintaining a continuous movement. This is apparent when we remember that the average freight car is actually moving in trains only about 10 per cent of the time, or a little over 2½ hours out of the 24. Obviously, there is opportunity to save many more car days by avoiding some of the lost time during the other 21½ hours than by running the already high-speed trains still faster for the 2½ hours they are moving the cars.

"Sympathetic consideration has been given to the appeals for priorities which will permit suppliers to fill railway orders, but the necessary action to bring deliveries is exceedingly slow. Transportation must be recognized as equally vital with any other part of the defense effort, and the time has come when such recognition must be expressed in necessary materials. The matter is not within my control or that of the railroads. It is not a question of their failure to place orders, nor their ability to pay for the goods."

Midget Gasoline-Propelled Locomotives for Army

"Midget locomotives, as easily operated as automobiles, yet able to pull trains of 15 loaded freight cars at a speed of 15 miles an hour, are being delivered to Army posts throughout the country," said a recent statement from the War Department.

Twenty-five of the locomotives already are working for the Army. Although the general plan is to use the midgets on standard gauge tracks, experimental tests at Fort Dix, N. J., "revealed they were adaptable to narrow gauge as well." There are many practical time-saving uses for the locomotive, according to Quartermaster Corps authorities.

OPM Moves to Recover Nickel Steel Scrap

A movement on the part of the Office of Production Management to convince railroads and other large users of alloy steels, particularly nickel steel, that usable alloy scrap should be segregated and returned to the steel industries for remelting were discussed at Washington, D. C., on July 8, at a meeting sponsored by the National Conference of Business Paper Editors. Attending the conference were Dr. C. H. Herty, Jr., research engineer, Bethlehem Steel Company, who is chairman of the new scrap conservation sub-committee of the American Iron & Steel Institute's Defense Committee; H. Leroy Whitney, chief of OPM's Nickel Section; D. A. Uebelacker, chief of OPM's Nickel Section; C. G. Holmquist of the office of Price Administration and Civilian Supply; T. H. Wickenden, assistant manager of the development and research department, International Nickel Company, and Robert A. Wheeler, advertising manager, Nickel Alloy Steel Division, International Nickel Company.

Mr. Uebelacker estimated that the present total nickel demand is running at about the rate of 21 million pounds per month. Of this he said 12½ million pounds per month are required to satisfy A rating priorities. At the present time there is available for distribution in the United States about 15 million pounds per month, leaving a shortage of about six million pounds per month of unsatisfied demand.

The scrap-recovery movement was started in the belief that a large supply of usable alloy scrap can be made available for remelting if it can be located and the using industries can be induced to take measures to effect an adequate segregation of alloy scrap material. A letter has been sent out to using industries by OPM suggesting a basis for segregation and grading of alloy scraps, first according to the amount of the principal alloying element and, thence, according to carbon content and the amount of stabilizing elements and elements added for machinability. These grades are grouped into two main classes—stainless steels and low-alloy steels—and the principal alloying elements involved are nickel, chromium, and molybdenum. Accompanying the letter to the using industries is a copy of a price sched-

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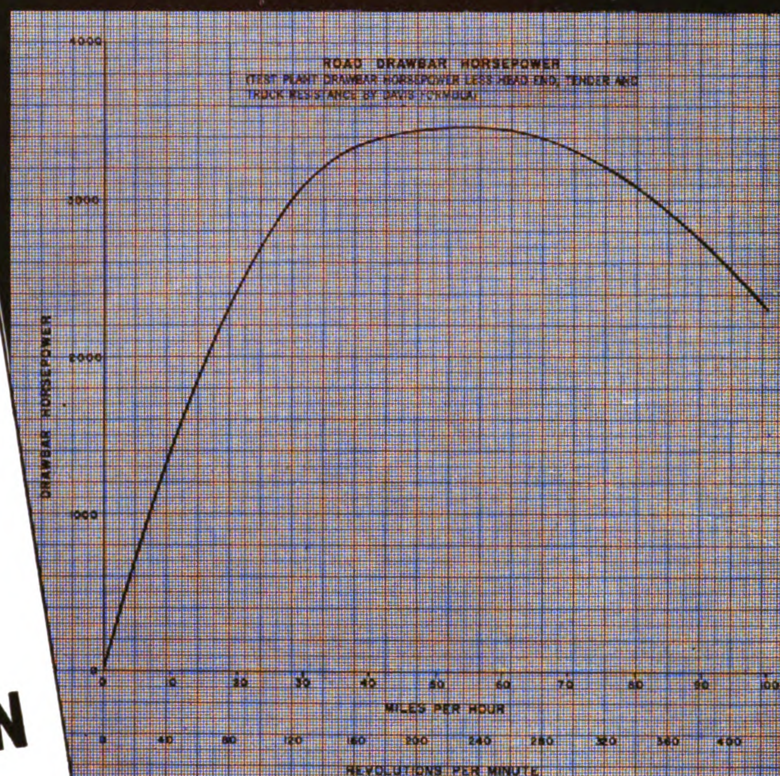
HIGHER SUSTAINED DRAWBAR HORSEPOWER

for Acceleration and Operating Speeds

through the Application of...



THE FRANKLIN SYSTEM OF STEAM DISTRIBUTION

The Franklin System of Steam Distribution, by providing the following features, secures results such as are indicated in the above curve.

1. Separation of valve events, so that admission, cut-off, release and compression are independently controlled.
2. Absolutely fixed valve events at all speeds and all cut-offs.
3. Large inlet and exhaust passages and improved steam flow.
4. Reduced cylinder clearance volume.
5. Reduced weight of moving masses and reduced mechanical friction.

The Franklin System of Steam Distribution is offered to the railroads to meet the increasing demand for a more complete utilization of the potential power in every pound of steam.

FRANKLIN RAILWAY SUPPLY COMPANY, INC. NEW YORK CHICAGO

In Canada: **FRANKLIN RAILWAY SUPPLY COMPANY, LIMITED, MONTREAL**

ule issued by OPACS in fixing maximum price of nickel-steel scrap and giving other information governing grading and quantity differentials.

Mr. Whitney expects most users to find that the higher prices which the properly segregated, uncontaminated alloy scrap will command will be ample economic justification for the expense involved in effecting the proper segregation.

The steel scrap conservation sub-committee of the American Iron & Steel Institute is developing plans for finding out where the alloy scrap is located, how much of it there is, and what facilities are available for its proper preparation, where processing is necessary before shipment.

Equipment Purchasing and Modernization Programs

Baltimore & Ohio.—Division 4 of the Interstate Commerce Commission has modified its Equipment Trust Certificate order of November 19, 1940, in Finance Docket No. 130079, so as to permit this company to substitute 274 70-ton, 53 ft. 1½ in. all-steel gondola cars in place of 250 70-ton, 66 ft. 1½ in. all-steel gondola cars as originally contemplated.

Cambria & Indiana.—The Cambria & Indiana has placed an order for repairs to 400 hopper cars with the Bethlehem Steel Company.

Canadian Pacific.—A contract has been awarded Couture and Toupin, Winnipeg, Man., for the construction of a scrap reclaiming building at Weston shops. The work involves the construction of a brick and concrete building 50 ft. x 96 ft. x 15½ ft., at a cost of $18,000.

A contract on a cost plus basis has been awarded to C. M. Miners Construction Company, Ltd., Saskatoon, Sask., for the installation of a 90-ft. turntable at Sutherland, Sask.

Chicago, Burlington & Quincy.—The Burlington has asked the Interstate Commerce Commission for authority to assume liability for $9,387,000 of 1½ per cent equipment trust certificates, maturing in seven annual installments of $1,341,000 each on August 1 in each of the years from 1942 to 1948, inclusive. The proceeds will be used as part of the purchase price of new equipment costing a total of $11,043,530 and consisting of 2,000 40-ft. 6-in., 50-ton steel frame, double-sheathed box cars with steel outside sheathing; 500 50-ft. 6-in., 50-ton steel frame, double-sheathed box cars with steel outside sheathing; 175 50-ft. 6-in., 50-ton steel frame, double-sheathed automobile cars with steel outside sheathing with auto loaders; 50 29-ft. 3-in., 70-ton all-steel, covered hopper cars; 100 65-ft. 6-in., 70-ton, all-steel gondola cars; 250 34-ft. 3-in., 55-ton, all-steel hopper cars; 400 53-ft. 6-in., 50-ton, all-steel flat cars; 200 40-ft. 6-in., 40-ton steel frame stock cars; and 250 40-ft. 8-in., 70-ton all-steel ballast cars, making a total of 3,925 cars. Orders placed with the company shops were announced in the March issue.

Gulf, Mobile & Ohio.—The G. M. & N. has asked the Interstate Commerce Commission for authority to assume liability for $2,175,000 of 2.4 per cent equipment trust certificates, maturing in 15 equal annual installments of $145,000 on August 1 in each of the years from 1942 to 1956, inclusive. The proceeds will be used as a part of the purchase price of new equipment costing a total of $2,853,000 and consisting of 800 40-ton, 40-ft. 6-in. box cars; 150 50-ton twin, self-clearing hopper cars; and 50 40-ton, 40-ft. 6-in. automobile box cars. Orders for this equipment were announced in the July issue.

When filing this petition the G. M. & N. pointed out that while it has equipment sufficient to handle normal business it considers it its duty to provide itself with the facilities that will enable it to do its part in supporting the government's preparation for defense.

Illinois Central.—The Illinois Central has asked the Interstate Commerce Commission for authority to assume liability for $6,920,000 of equipment trust certificates, maturing in 20 semi-annual installments of $346,000, beginning September 1, 1941. The proceeds will be used as part of the purchase price of new equipment costing a total of $7,699,166 and consisting of 1,000 40-ton box cars; 1,000 50-ton hopper cars; 200 40-ton refrigerator cars; 100 70-ton covered hopper cars, and 100 50-ton flat cars. Orders for this equipment were announced in the May issue.

Missouri-Kansas-Texas.—An elaborate car rehabilitation program calling for the rebuilding of more than 2,000 freight cars is being undertaken by the M-K-T at its Denison shops. Included are 1,500 box, 500 gondola and 30 caboose cars. A force of 100 men are already at work on the construction of the first 10 cabooses, 2 of which are already in service.

Following completion of the cabooses, Denison shop forces will sandblast and paint 200 hopper cars. This work will be done pending the arrival of materials and supplies needed for the car building program.

Of the box cars to be rebuilt, 1,000 are of the 76000 series, which were built by the American Car & Foundry Company at St. Charles, Mo., in 1923. Many of the remaining 500 box cars are of the 96000 series, built at Denison in 1926. The 76000 series cars are 80,000-lb. capacity units with steel frames, posts, braces and roofs and with longitudinal wood siding, mounted inside the steel braces. The 96000 series are of the same construction but are of 100,000-lb. capacity.

New York Central.—Five stalls of the enginehouse on the Big Four at Bellefontaine, Ohio, will be extended to accommodate the installation of a 100-ton and a 50-ton drop table, and a monorail crane. The contract for the enginehouse extension has been awarded the Walsh Construction Company, and for the drop tables, the Whiting Corporation. The cost of the project, including sewer and water line changes and a fan and heater room, is estimated at $102,000.

Northern Pacific.—A contract has been awarded the J. W. Bailey Construction Company, Seattle, Wash., for the construction of a three-track wood frame rectangular enginehouse with a machine bay, a wood frame office and store building, and a concrete cinder pit at Easton, Wash. In connection with this work, track rearrangements and changes to water facilities will be completed by company forces.

Wabash.—The Wabash has asked the district court for permission to purchase materials for the construction of 100 freight cars in company shops at a cost of $350,000.

Western Maryland. — The Western Maryland has asked the Interstate Commerce Commission for authority to assume liability for $1,900,000 of 2⅛ per cent equipment trust certificates, maturing in 10 equal annual installments of $190,000 on August 1 in each of the years from 1942 to 1951, inclusive. The proceeds will be used as a part of the purchase price of new equipment costing a total of $2,204,000 and consisting of 200 all-steel, 50-ton box cars with chilled iron wheels; 300 all-steel, 50-ton hopper coal cars, with one-wear steel wheels; 200 all-steel, 50-ton gondola cars with wood floors and chilled iron wheels; and 25 50-ton flat cars with chilled-iron wheels. Orders for this equipment were announced in the July issue.

Western Pacific.—The Western Pacific has asked the Interstate Commerce Commission for authority to assume liability for $2,650,000 of equipment trust certificates, maturing in 10 equal annual installments of $265,000 on August 1 in each of the years from 1942 to 1951, inclusive. The proceeds will be used as part of the purchase price of new equipment costing a total of $3,588,560 and consisting of three 5,400 hp. Diesel-electric freight locomotives; 350 50-ton, 40-ft. box cars; 300 50-ton, 50-ft. flat cars, and four stainless steel-sheathed, streamline chair cars. Orders for this equipment were announced in the July issue.

OPACS Gives Preferential Status for Locomotive and Car Materials

Action "to relieve a critical shortage of locomotives of all kinds" was taken by the Office of Price Administration and Civilian Supply on July 7 when it made public an allocation program "giving preferential delivery status" to materials and equipment essential to locomotive construction. On the same day, OPACS also acted "to secure adequate transportation facilities for the traveling public," issuing another allocation program providing preferential status on materials and equipment used in the construction of cars and buses "for urban or interurban lines."

The locomotive materials program set forth that "there is a critical shortage in the nation's locomotives"; it is applicable to material and equipment entering into "railroad, mine and industrial locomotive construction—steam, electric or Diesel." Likewise the program in connection with passenger equipment for urban and interurban lines was based on a finding that "there is a critical shortage in the nation's coaches and rail-cars." These latest moves place the equipment involved in the same OPACS class as the materials for freight-car construction covered in a previous allocation program issued June 10. In other

(Continued on next left-hand page)

"Tailor Made"

YET STANDARDIZED!

Each Security Arch is "tailor made" to suit the individual class of power in which it must function. But so effectively is Security Arch Brick standardized that only six different Security Brick patterns are needed for more than 50% of the Security Arch Brick used.

This high standardization reflects the engineering and experience of the American Arch Company.

It simplifies the application of the brick arch and saves the stores department a vast amount of trouble.

This foresight of the American Arch Company in adhering to standards is but one of the many ways in which the American Arch Company is serving the railroads.

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SECURITY ARCHES
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HARBISON-WALKER REFRACTORIES CO.

Refractory Specialists

AMERICAN ARCH CO.
INCORPORATED
60 EAST 42nd STREET, NEW YORK, N. Y

Locomotive Combustion Specialists

words, as it is stated in the locomotive program, "all deliveries of material and equipment necessary for the construction of locomotives shall be given preference over all material and equipment going into any other civilian use, subject, however, to a prior preference to deliveries for all such material and equipment as may be required under contracts with the United States or any department or agency thereof."

The civilian allocation program for freight cars issued on June 10 will, according to Leon Henderson, administrator of OPACS, "affect particularly the distribution of available supplies of steel and its products since they constitute a major part of the materials required in freight-car construction. It is estimated that an average of 20 tons of steel are required for each freight car built. Completion this year of all the freight cars on order May 1 would require around 1,400,000 tons of steel."

OPACS After Wheel Builders

RAILROAD car-wheel builders were asked during the latter part of June to withdraw "the substantial price increase they had proposed to put in effect July 1" and, instead, to meet for discussions on the matter with representatives of the Office of Price Administration and Civilian Supply in Washington.

The request was contained in a letter sent June 23 to 16 car wheel manufacturers by Leon Henderson, OPACS administrator, who said his office could continue its present policy of inviting voluntary co-operation, rather than formal controls, "only so long as individual businesses are willing to assume the responsibility of maintaining price stability." Confidence was expressed by the administrator that the need for further action in the present situation could be avoided. The car-wheel industry has had a position of "strategic importance" in the defense effort, the letter pointed out, in addition to its place in the general industrial economy.

D. & R. G. W.—Climax Molybdenum Party

ON July 17 and 18, the Denver & Rio Grande Western, in conjunction with the Climax Molybdenum Company, held "open house" for a party of railway engineers and manufacturers' representatives from various parts of the country who were invited to make a thorough inspection of the railroad's test laboratory at Denver, Colo., and the world's largest Molybdenum mine at Climax, Ohio. At the test laboratory, which is now being enlarged to accommodate a substantially increased volume of work, R. McBrian, engineer of tests, and his assistants explained the use of the various units of modern laboratory equipment, and described current test work, such as Thermoflux determination of laminated sections in boiler plate and firebox steel; Magnaflux tests of locomotive and car parts; dampening capacity tests as a measure of the aging of metals; and use of polarized light to show stress patterns in plastic models. Physical tests of alloy firebox steels at controlled high temperatures indicate that the presence of molybdenum as an alloy has a definite tendency to give improved physical properties as compared with carbon steel at the high temperatures common in modern locomotive boiler operation.

On Friday, July 18, the inspection party, under the direction of D. R. Carse, New York representative of the carbon Molybdenum Company, and E. R. Young, metallurgical engineer, motored to the company mine at Climax and inspected the extensive operations whereby 12,000,000 lb., of molybdenum concentrate were produced in 1940. It is expected that this production will be stepped up to 20,000,000 lb. in 1941. The magnitude of the highly-mechanized process by which such large production figures are realized may be appreciated from the fact that molybdenum constitute only about six per cent by weight of the ore as mined.

I. C. C. Organization Changes

THE Interstate Commerce Commission has announced that Commissioner Miller has been assigned to Division 3 in lieu of Commissioner Alldredge. Division 3 now consists of Commissioners Mahaffie, Miller and Johnson, "except that Commissioner Patterson shall serve in lieu of Commissioner Miller with respect to matters arising under Section 25 (a)-(g), inclusive, of the Interstate Commerce Act, Railroad Retirement Act of 1937, Carriers Taxing Act of 1937, Railroad Unemployment Insurance Act, Railway Labor Act, Safety Appliance Acts, Locomotive Inspection Act, Ash Pan Act, Accident Reports Act, Hours of Service Act, Block Signal Resolution of June 30, 1906, Sundry Civil Appropriation Act of May 27, 1908, and Medals of Honor Act."

OPM Issues Priorities for Locomotive Builders; None for Passenger Cars

To alleviate problems caused by a serious shortage of locomotives, the priorities division of the Office of Production Management has issued two blanket preference rating orders—designed to facilitate both the construction of locomotives and their repair. A preference rating of A-3 will be granted to an initial list of 10 locomotive builders and also to about sixty repair plants, it was stated.

The two orders are similar in form to the blanket preference rating granted to freight-car builders as noted in the July issue, page 295. One of the new orders grants a rating for delivery of material entering into the repair and rebuilding of steam, electric or Diesel locomotives, whether for railroad, mining or industrial use. The other order grants a rating for delivery of materials entering into the construction of specified locomotives now scheduled by the builders.

Each producer or supplier granted the use of the new rating may apply it to deliveries of material entering into construction or repairs by executing a copy of the appropriate order and serving it on his suppliers. After the rating has been applied the first time, additional orders may be covered merely by citation of the rating granted originally, it was pointed out.

Use of the blanket ratings will, in the opinion of the priorities division, eliminate a great deal of paper work which is at present involved in making separate applications for ratings on each individual contract or order placed.

No OPM preference ratings will be issued for steel for passenger-car construction, it having been determined that there is no immediate necessity for such action.

Aluminum Production Expanding

THE use of aluminum, which has found its way extensively into passenger-car construction both as trim and as the primary structural material, is now confined exclusively as a raw material of the defense industries.

In 1939, when the Aluminum Company of America was sole producer of primary aluminum, its total production was 327 million pounds. This company alone has under way a program of expansion which will have increased its output to 720 million pounds, or more than doubled, by mid-summer of 1942. Other plants to be owned by the government have been projected which will raise the total capacity of the aluminum producing industry to 1,400 million pounds when they have been completed. Three of these plants will be operated by the Aluminum Company of America; one by the Union Carbide and Carbon Company; one by the Reynolds Metal Company; one by the Bohn Aluminum & Brass Company, and one by the Olin Corporation. These seven federally owned plants are located adjacent to various large water-power sources, most of them built by the government.

Conferences with Engineers and Firemen Break Up Over Diesel Demands

CONFERENCES took place during June at Chicago between a committee representing the Western railways and committees representing the Brotherhood of Locomotive Engineers and the Brotherhood of Locomotive Firemen and Enginemen on the demands which the engineers made on March 18, 1939. The demands of the engineers call for rates of pay based upon horsepower of Diesel locomotives instead of weights on drivers and for an assistant engineer in the engine rooms of certain types of Diesel locomotives. The demands which the firemen made on May 10, 1941, involve higher pay on Diesel and coal-burning locomotives and a fireman-helper on each unit of locomotives. The conferences broke up on July 3, due to the continued demands of the engineers and firemen for the employment of extra men on Diesel-electric locomotives.

"We see neither reason nor justice in the

demands for the employment of additional and unneeded men on Diesel locomotives," said F. G. Gurley, chairman of the Western Carriers' Conference Committee. "The demands of the engineers and firemen would require, on a Diesel such as that used on the transcontinental City of San Francisco, the employment of seven enginemen—one engineer, three 'assistant engineers' and three firemen. This train is now being operated safely and efficiently with two enginemen—one engineer and one fireman.

"The City of San Francisco, in its journey from Chicago to the Coast, runs over 15 so-called 'operating districts.' Engine crews are changed for each operating district. Thus, under the present demands, 105 enginemen would be required to handle the locomotive on a trip requiring only 39 hours and 45 minutes. In view of the fact that 15 engine crews are used in a period of less than 40 hours, it is obvious that these men, on the average, now work only between two and three hours a day; yet they receive a minimum of 8 hours' pay. The 105 men, who would be required under the present demands to handle this train in one direction, represent an increase of 75 over the present number required. All that these extra employees would do would be to ride, to draw their pay, and to increase the cost of rail transportation.

"We have been ready and willing, as a basis for disposing of these demands, to discuss with these men changes in the basis upon which their present daily rates of pay are established. We see no justification, however, for the employees to attempt to secure a wage increase through a change in the basis on which they are paid. This is particularly true when there are now before us demands for an increase of 30 per cent in pay on top of this other wage increase. In other words, the engineers and firemen are demanding a compound increase in pay—an increase on top of another increase.

"We have offered to attempt a disposition of these demands by a change in the present method of fixing rates of pay for engineers and firemen on Diesel-electric locomotives, but only upon a sound and reasonable basis, and not as a wage increase in disguise. The employees, however, have stated that no change in the basis of pay for operating Diesel-electric engines would cause them to withdraw their demands for the additional and unnecessary personnel.

"Certainly, no group of railroad officers, with justice to themselves or to the people who are entitled to demand from them reasonably intelligent and courageous management of the properties entrusted to them, can agree to any such proposals."

Supply Trade Notes

HERBERT J. WATT has been appointed manager of sales, western area, for the Carnegie-Illinois Steel Corp., with headquarters in Chicago. Mr. Watt will coordinate sales activities of the company's offices at Chicago; Denver, Col.; Detroit, Mich.; Indianapolis, Ind.; Milwaukee, Wis.; St. Louis, Mo., and St. Paul, Minn.

◆

T. H. MURPHY has been appointed superintendent of Diesel power of the American Locomotive Company with headquarters at Schenectady, N. Y. Mr. Murphy

T. H. Murphy

graduated from the University of Virginia with a degree in electrical engineering in 1923. From 1923 to 1924, he worked on the special test course and attended the engineering school of the Westinghouse Electric & Manufacturing Co., subsequently entering that company's railway engineering department. From 1926 to 1927 he acted as special engineering representative at the J. G. Brill plant at Philadelphia, Pa. Later, he was stationed at the South Philadelphia plant of the Westinghouse Electric & Manufacturing Co. in connection with Diesel locomotive work, where he remained until 1936. In October, 1936, after a few months of shop engineering development work at the Weirton Steel Company, he entered the employ of the American Locomotive Company, where he engaged in special work on Diesel locomotives in the engineering department at that company's New York office. Mr. Murphy was transferred to the Schenectady, N. Y., plant early in 1941.

◆

STEWART MCNAUGHTON has been appointed general sales manager of the Locomotive Division of The Baldwin Locomotive Works, in charge of all steam and Diesel locomotive sales. Mr. McNaughton was born in Philadelphia, Pa., and obtained his education in the Central High

S. McNaughton

School and the Franklin Institute of that city. He became associated with The Baldwin Locomotive Works in 1899 as a mechanical draftsman and for the next fifteen years devoted his time to the various phases of locomotive design and engineering. In 1915 he entered the sales department as manager of the locomotive spare and repair parts activities of the company, and in 1919 was given general supervision over steam locomotive sales.

◆

JOHN S. HUTCHINS, who has been in charge of sales in the Chicago district for the Ramapo Ajax division of the American Brake Shoe and Foundry Company, New York, has been promoted to district

John S. Hutchins

sales manager for this division in charge of the entire middle west territory, with headquarters at Chicago, to succeed Paul Hoffman, retired. Mr. Hutchins was born at Arlington, Mass., on December 30, 1904, and after attending Yale University, entered the employ of Ramapo Ajax at Chicago in September, 1925. Two years later he was transferred from the plant to the sales department and in 1930 was moved to the Cleveland office. In 1933 he was placed in charge of sales in the Chicago district.

◆

PULLMAN-STANDARD CAR MANUFACTURING COMPANY.—*Andrew Christian-*

(Continued on second left-hand page)

Royal Blue
Washington—New
Columbian
New York—Washington
Diplomat
Washington—St. Louis
National Limited
Washington—St. Louis
Capitol Limited
Washington—Chicago
Shenandoah
Washington—Chicago
61
B A L T I

son, consulting engineer of Pullman-Standard, Chicago, has been granted a six-months leave of absence. The duties of his office are being assumed by *E. W. Test*, assistant to the president in charge of engineering and research.

◆

Horace M. Wigney has been appointed assistant vice-president of the equipment specialties division of the Union Asbestos and Rubber Company, Chicago. For the last year Mr. Wigney has engaged in special work on the Pacific Coast for the City Ice & Fuel Company of Cleveland, Ohio. For twelve years, prior to 1940 he served as vice-president and general manager of Safety Refrigeration, Inc., a subsidiary of the Safety Car Heating and Lighting Company, New York. For a number of years he also was general superintendent of the Merchants Despatch Transportation Corporation at Rochester, N. Y., and superintendent of transportation of the Pacific Fruit Express Company, from 1907 to 1915.

◆

Machinery & Allied Products Institute.—*George Terborgh* has been elected secretary of the Machinery & Allied Products Institute, national federation of machinery manufacturers, to succeed *Alexander Konkle*, who has resigned to re-enter private business. Mr. Terborgh had been senior economist of the Board of Governors of the Federal Reserve Bank at Washington, D. C.

◆

Iron & Steel Products, Inc.—*Paul G. Cheatham, Jr.*, has been appointed Mexican representative of Iron & Steel Products, Inc., Chicago, with headquarters at Mexico City, D. F., to succeed *P. C. Morales*, who has resumed the position of general superintendent of motive power and machinery of the National Railways of Mexico, from which he resigned in 1935.

◆

Oakite Products, Inc.—*Bennett C. Browning*, special representative of Oakite Products, Inc., New York, with headquarters at Chicago, has been appointed manager of the railway service division, with the same headquarters. *Hobart F. Cooke* and *Frank C. Lipcomb*, who have represented the industrial division in the Omaha and in the Tennessee-Alabama territories, have been transferred to the enlarged railway service division at Chicago.

Obituary

Otto V. Kruse, general sales manager of the Baldwin Locomotive Works, died at his home in St. Davids, Pa., July 1. He was 54 years of age. Mr. Kruse graduated from Cornell University in 1909 with the degree of Civil Engineer. He was active in the hydro-electric industry up to the year of 1917, at which time he became consulting engineer to the Larner Engineering Company and the William Cramp & Sons Ship and Engine Building Co. He was subsequently appointed general sales manager of the miscellaneous machinery business of the Cramp company. In 1931 the Baldwin Locomotive Works acquired this business and Mr. Kruse later became general sales manager and finally assistant manager of the division of this business known as the Baldwin-Southwark Corporation. He became general sales manager of the Baldwin Locomotive Works in 1939.

Otto V. Kruse

◆

George H. Jones, one of the founders of Inland Steel Co., died July 6 in his home in Chicago at the age of 85. In 1893, he joined in organizing Inland Steel Co. Mr. Jones' first position with the company was that of vice-president; he was the chief executive officer and was also in charge of sales. He became the second president in 1898 and served in that capacity until 1906. He served in other executive positions until 1921 and had continued as a director of the company since that time.

◆

Edward H. Dickinson, assistant to the vice-president of sales, American Locomotive Company, died July 9 at his home in Ridgewood, N. J.

◆

Dudley Brewster Bullard, vice-president of the Bullard Company of Bridgeport, Conn., who died on June 10, as announced in the July issue of the *Railway Mechanical Engineer*, received his early engineering education as an apprentice in the plant of his father, who founded the Bridgeport Machine Tool Works which later became the Bullard Company. After several years spent in the machine shop he was advanced to the drafting room and subsequently appointed superintendent of the plant. From this position he became chief engineer and finally vice-president in charge of engineering. Mr. Bullard was a member of the A. S. M. E. and had served as chairman of the Bridgeport chapter from 1931 to 1932. He was also a member of the Bridgeport Engineers' Club and its president in 1930.

Dudley Brewster Bullard

Personal Mention

General

Emil C. Anderson, mechanical engineer of the Chicago, Burlington & Quincy at Chicago, retired on July 1, after 47 years' railway service.

J. F. Jennings, superintendent of equipment of the Michigan Central with headquarters at Detroit, Mich., retired on June 30 after 50 years of service.

Revelle W. Brown, vice-president (operations and maintenance) of the Reading and its affiliated Central of New Jersey, has been elected president of the Lehigh Valley. Mr. Brown was born August 5, 1883, at Carlyle, Ill. After attending public schools and Carlyle high school, he entered railroad service July 19, 1901, as a laborer on the Baltimore & Ohio. Later, he was successively a fireman, a locomotive engineer, an air-brake instructor, and assistant road foreman of engines, Illinois division. After several further positions in the motive power field he held various positions in the operating department of the B. & O., becoming general manager of the Central of New Jersey at New York on December 1, 1930. Six months later he was appointed also a vice-president, and on December 27, 1935, became vice-president in charge of operation and maintenance, Reading and Central of New Jersey.

A. H. Ream, superintendent of motive power and equipment of the Pittsburgh & Shawmut, with headquarters at Brookville, Pa., has retired from active duty at his own request, after 48 years of railroad service, 25 years of which has been in the service of the Pittsburgh & Shawmut.

W. G. Reid, master mechanic of the Rio Grande division of the Southern Pacific with headquarters at El Paso, Tex., has been appointed assistant superintendent of motive power with headquarters

(*Continued on next left-hand page*)

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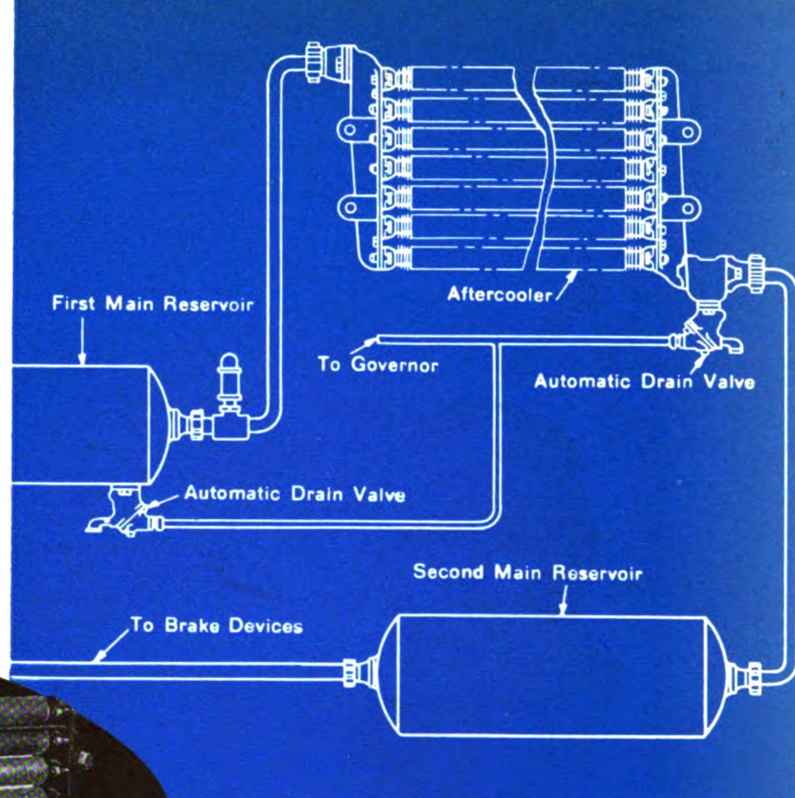
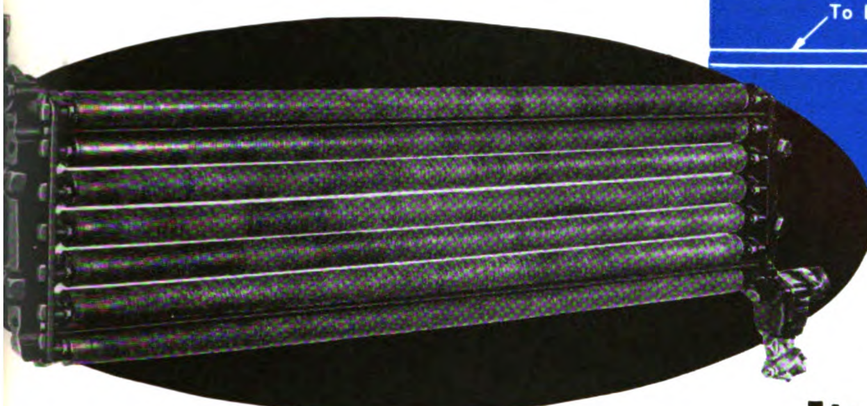




. . . AFTERCOOLER and Automatic Drain Valve

This radiator type Aftercooler, comprising a set of parallel finned copper tubes, produces a far better cooling effect, and has much greater frost carrying capacity, than the conventional type of series radiating pipe. It is compact, and can be installed on the front end of a locomotive away from boiler radiation and in the path of air currents. Throttling orifices insure a substantially uniform distribution of air flow through the tubes, and a twisted stainless steel ribbon in each tube acts as a baffle to force air into contact with the walls. An Automatic Drain Valve ejects precipitated moisture each time the governor operates either to start or stop the compressor.

Here is one instance of Its Remarkable Efficiency

During a certain run on a particular railroad, the temperature may vary from moderately warm to sub-zero. Before making this trip recently a locomotive that had no Aftercooler was inspected, and all parts of the brake system were then free from moisture. At the summit of the mountain, however, after a 30 mile run, considerable water was in the second main reservoir, in the drain cup, and was dripping from the tender hose. At the end of a similar trip *with a locomotive that had an Aftercooler, the corresponding parts were bone dry* ★ Here then is a way to avoid trouble with moisture in *your* brake system. Think what the assurance of dry air will mean to *you* in maintaining the integrity of brake performance, with resultant uninterrupted train service!

WESTINGHOUSE AIR BRAKE COMPANY
WILMERDING PENNSYLVANIA

at El Paso. Mr. Reid entered the employ of the Southern Pacific in 1903 as a machinist apprentice at Tucson, Ariz., and in 1907-8 was a machinist on the Southern Pacific of Mexico at Guaymas. From 1908 to 1913 he served as a machinist on the Arizona Eastern at Globe, Ariz. In the latter year he was promoted to foreman and later to general foreman on that road. In 1918 he became trainmaster at Globe and,

W. G. Reid

a short time later, master mechanic at Phoenix, Ariz. In 1924 Mr. Reid was transferred to El Paso.

MATHEW ROY BENSON, assistant superintendent of equipment of the Michigan Central at Detroit, Mich., has been appointed superintendent of equipment, with headquarters at Detroit. Mr. Benson was born at St. Thomas, Ont., on May 31, 1889, and entered railway service on July 10, 1906, as an apprentice in the shops of the Michigan Central at St. Thomas.

Mathew Roy Benson

On December 1, 1906, he became a machinist apprentice in the locomotive shops, and four years later was appointed a machinist. From March 30, 1911, to May 3, 1913, Mr. Benson worked for several automobile industries at Detroit, and on the Canadian Pacific, returning to the Michigan Central on the latter date as a machinist. On October 1, 1913, he was promoted to piecework inspector, and on April 1, 1916, became wrecking shop foreman. Five months later he became chief piecework inspector, and on October 1, 1920, was advanced to the position of general foreman. Mr. Benson was appointed superintendent of shops at Jackson, Mich., on April 16, 1925; master mechanic at St. Thomas on February 1, 1926, and assistant superintendent of equipment on February 1, 1941.

CHARLES A. GILL, general manager of the Reading and Central of New Jersey, with headquarters at Reading, Pa., was elected vice-president in charge of operation and maintenance at a special meeting of the board of directors on July 15, to succeed R. W. Brown, who has been elected president of the Lehigh Valley. Mr. Gill was born at Buffalo, N. Y., on January 19, 1884. After receiving a public school education in Baltimore, Md., he entered the service of the Baltimore & Ohio at the Riverside shops in 1897, later becoming a machinist apprentice. Between 1901 and 1909 Mr. Gill served as a machinist on the Northern Central, foreman on the Chicago, Burlington & Quincy at Sheridan, Wyo., and foreman on the Northern Pacific at Livingston and Missoula, Mont., and Wallace, Idaho. In 1909 Mr. Gill again became affiliated with the Baltimore & Ohio as an enginehouse foreman at Washington, Ind. He then became master mechanic on the Cincin-

Charles A. Gill

nati, Hamilton & Dayton, Dayton & Union (now both part of the Baltimore & Ohio), and Chicago & Illinois Western in 1912. In 1913 Mr. Gill became general master mechanic of the Maryland district of the Baltimore & Ohio and four years later was appointed superintendent motive power of the eastern lines. In 1931 Mr. Gill was loaned by the Baltimore & Ohio to the Russian government for the purpose of rehabilitating the motive power and railroad shops of that country. He remained in Russia for a year, during which time he virtually reorganized the rail transportation of that country. In 1932 Mr. Gill was appointed assistant chief of motive power of the Baltimore & Ohio and special representative to the operating vice-president of the Reading. Later in 1932 he was appointed superintendent motive power of the Reading and the Central of New Jersey, of which roads he became general manager in 1936. Mr. Gill is a member of the executive committee of the New York Railroad Club. He was president of the club during 1937-1938.

WARREN P. HARTMAN has been appointed mechanical superintendent of the Western district of the Atchison, Topeka & Santa Fe. Mr. Hartman was born at Longmont, Colo., on February 1, 1891, and was graduated from the University of Colorado in 1914. In the same year he entered the employ of the Santa Fe as a

Warren P. Hartman

special apprentice at La Junta, Colo. After serving as apprentice instructor, erecting gang foreman at Raton, N. M., general erecting foreman at La Junta, and enginehouse foreman at Raton and Albuquerque, he was promoted to general enginehouse foreman at Albuquerque on July 10, 1924. On December 1, 1930, he was promoted to fuel supervisor at Amarillo, Tex.; on February 1, 1934, was promoted to master mechanic of the Slaton division at Slaton, Tex., and on July 6, 1934, was transferred to the Kansas City and Eastern divisions at Argentine, Kan.

JAMES M. NICHOLSON, who has been appointed general assistant, mechanical department of the Atchison, Topeka & Santa

James M. Nicholson

Fe, as reported in the July issue of the *Railway Mechanical Engineer*, was born at Scranton, Kan., on February 24, 1888, and

was graduated from Kansas State College in 1912. In the following year he entered the test department of the Santa Fe and in May, 1916, became laboratory foreman. He served as fuel supervisor at Ft. Madison, Iowa, from August, 1916, to May, 1921, when he was promoted to assistant engineer of tests at Topeka, Kan. In January, 1923, he became system fuel conservation engineer at Topeka and in November, 1930, was master mechanic at Slaton, Tex. In February, 1934, he was transferred to Argentine, Kan., and on July 1, 1937, to Chicago. He was appointed mechanical superintendent of the Western district, Eastern lines, with headquarters at Topeka, on July 20, 1937, which position he held until his appointment as general assistant, mechanical department.

Frank C. Watrous, road foreman of engines of the Pittsburgh & Shawmut, has been appointed superintendent of

Frank C. Watrous

the transportation and mechanical departments, with headquarters as before at Kittanning, Pa. Mr. Watrous was born in Sheridan, Ohio, and entered railway service with the Erie as hostler and locomotive fireman at Bradford, Pa., later being employed as a fireman on the Chicago, Rock Island & Pacific. He then served with the Pittsburg, Shawmut & Northern as trainman, with the Erie as engineer on the Bradford division, and with the Pittsburg, Shawmut & Northern as engineer. He went with the Pittsburg & Shawmut as engineer when that road started independent operation on September 1, 1916, and on January 10, 1918, was appointed road foreman of engines. On November 1, 1925, at his own request, he returned to engine service. Last January he became trainmaster and road foreman of engines.

Master Mechanics and Road Foremen

C. S. Burns, division master mechanic on the Canadian Pacific at Montreal, Que., has been transferred to the Smiths Falls (Ont.) division.

E. J. Burck, master mechanic on the Michigan Central at St. Thomas, Ont., has been transferred to Jackson, Mich. A sketch and photograph of Mr. Burck appeared on page 167 of the April issue.

F. E. Russell, Jr., assistant master mechanic of the Southern Pacific at Roseville, Calif., has been appointed master mechanic, with headquarters at El Paso, Tex.

H. D. Eddy, master mechanic of the Atchison, Topeka & Santa Fe at Clovis, N. M., has been transferred to the position of master mechanic at Winslow, Ariz.

Paul J. Danneberg, master mechanic on the Albuquerque division of the Atchison, Topeka & Santa Fe at Winslow, Ariz., has been transferred to the position of master mechanic at Argentine, Kan.

E. R. Auton, assistant master mechanic of the Southern Pacific at West Oakland, Calif., has been appointed master mechanic of the Western division, with headquarters at Oakland.

B. F. Madden, assistant master mechanic of the Southern Pacific at Sparks, Nev., has been appointed master mechanic of the newly-created Shasta division, with headquarters at Dunsmuir, Calif.

W. W. Lyons, master mechanic of the Atchison, Topeka & Santa Fe at Slaton, Tex., has been transferred to the position of master mechanic at Clovis, N. M.

L. B. Johnson, general foreman of the locomotive department of the Atchison, Topeka & Santa Fe at Clovis, N. M., has been appointed master mechanic of the Panhandle & Santa Fe, at Slaton, Tex.

Car Department

Kenneth H. Carpenter, assistant superintendent of the car department of the Delaware, Lackawanna & Western, has been appointed superintendent of the car department, with headquarters as before at Scranton, Pa., succeeding the late Paul H. Mitchell, deceased. Mr. Carpenter was born at Fontanelle, Neb., on June 25, 1898, and entered railroad service in 1920 as a

Kenneth H. Carpenter

carman with the Union Pacific at Omaha, Neb., in which capacity he served until 1922, when he went with the Missouri Pacific in a similar capacity. He served with the latter road until 1939, becoming lead inspector in 1924; assistant car foreman in 1926; car foreman in 1928; traveling car inspector in 1929, and general car foreman in 1933. Mr. Carpenter became assistant superintendent of the car department of the D. L. & W. at Scranton in 1939.

Obituary

F. P. Neesley, master mechanic on the Michigan Central at Jackson, Mich., died suddenly at his home in that city on June 12.

George Franklin Hess, who retired on April 18, 1940, as superintendent of motive power of the Wabash, with headquarters at Decatur, Ill., died on June 27 at Martinsville, Ind. He had been in poor health for some time. Mr. Hess was born at Ft. Wayne, Ind., on January 1, 1872, and entered railway service as a messenger boy in the mechanical department of the Pennsylvania in 1886. In March, 1887, he became a machinist apprentice in the Pennsylvania shops at Ft. Wayne, and four years later was appointed a machinist. He later served the Cleveland & Pittsburgh (now part of the Pennsylvania) at Wellsville, Ohio; the Cleveland, Canton & Southern (now part of the Wheeling & Lake Erie) at Canton, Ohio; the Atchison, Topeka & Santa Fe, at Raton, N. M.; the Cleveland, Cincinnati, Chicago & St. Louis (Big Four), at Wabash, Ind.; and the Wabash at Ft. Wayne, Ind. In Sep-

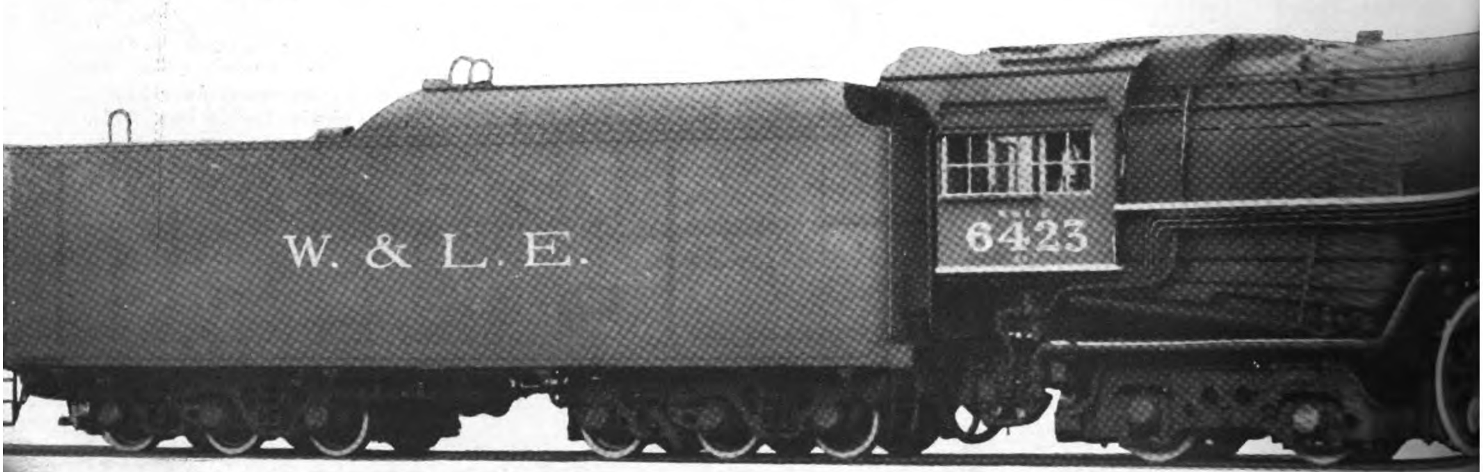
George Franklin Hess

tember, 1897, he was promoted to enginehouse foreman at Montpelier, Ohio, and short time later was transferred to Delray, Mich. In May, 1899, he went with the Grand Trunk Western as general foreman at Detroit, Mich., and later served the Chicago, Rock Island & Pacific as enginehouse foreman at Pratt, Kan., and at Caldwell, Kan. In July, 1902, Mr. Hess was advanced to general foreman of the 47th Street (Chicago) shops, and in March, 1903, he went with the Baltimore & Ohio as erecting foreman at Newark, Ohio. One month later, he was appointed general foreman at South Chicago, and in June, 1903, he was promoted to master mechanic at Lorain, Ohio. In November, 1910, he was transferred to Chillicothe, Ohio, and on August 1, 1911, he was appointed superintendent of machinery of the Kansas City Southern, with headquarters at Pittsburg, Kan. Mr. Hess was appointed superintendent of motive power of the Wabash, with headquarters at Decatur, Ill., on June 1, 1920.

10
DELIVERED IN APRIL
1937

5
DELIVERED IN DECEMBER
1938

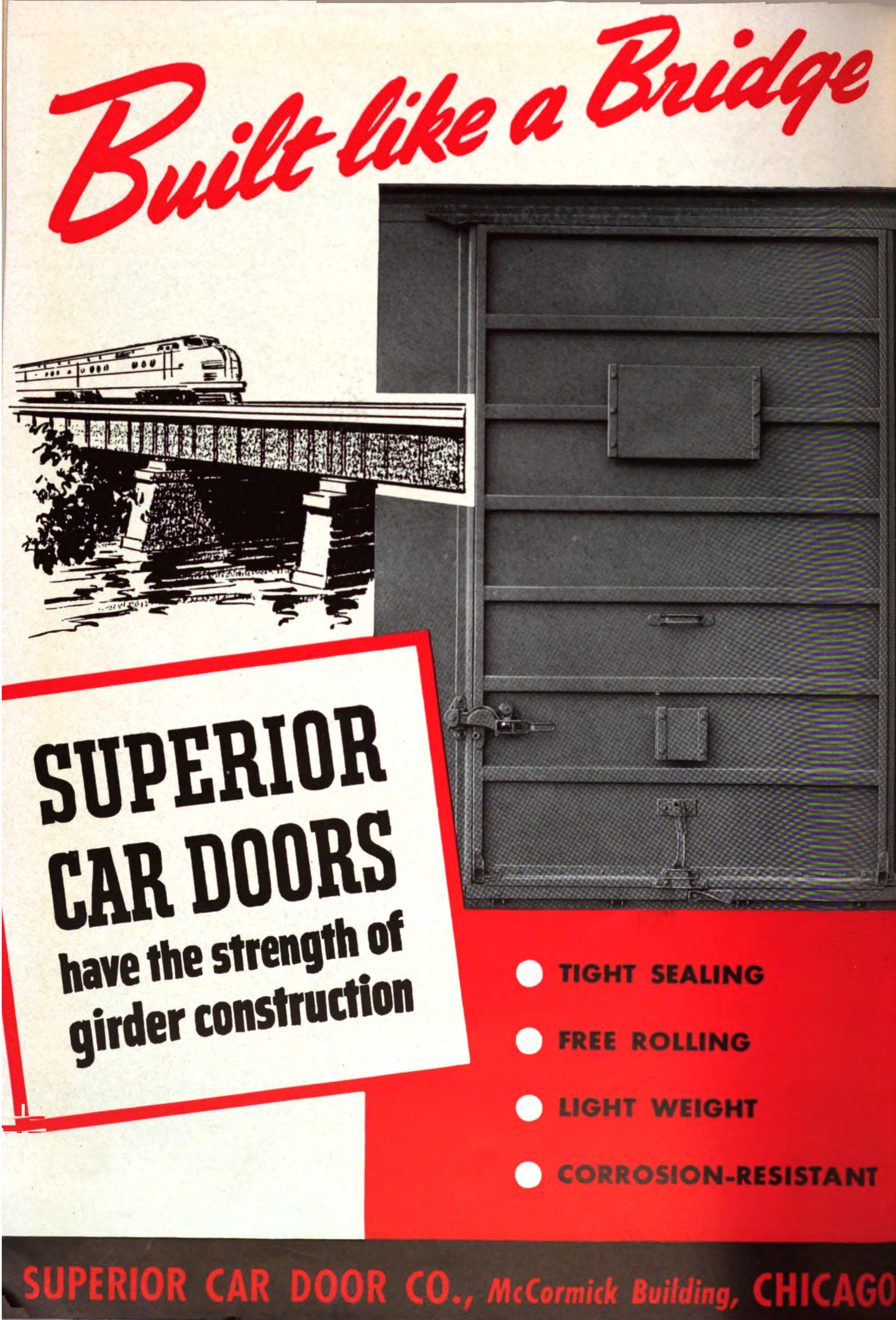
7
DELIVERED IN FEBRUAR
1941



Railway Mechanical Engineer

September 1941

FOUNDED IN 1832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RAILWAY
MECHANICAL ENGINEER

More Aluminum-Alloy

Streamliners to West Coast

Two additional 14-car trains—the "City of San Francisco" and the "City of Los Angeles"—added to C. & N. W.—U. P.—S. P. and C. & N. W.—U. P. fleets

Two 14-car aluminum-alloy streamliners have recently been placed in service on 39¾-hr. schedules between Chicago and the Pacific Coast. The City of San Francisco, which went into service on July 26, replaces the Forty Niner, which formerly operated on a 54-hr. schedule, between Chicago and San Francisco via the Chicago & North Western, the Union Pacific, and the Southern Pacific. The City of Los Angeles began its service life on August 3 over the Chicago & North Western and the Union Pacific, replacing the former City of Los Angeles train, the "Copper King," which has been assigned to service between Chicago and Portland, Ore. The motive power for each train is a 6,000-hp., three-unit Diesel-electric locomotive built by the Electro-Motive Corporation. The 28 cars in these two trains are drawn from a lot of 14 railroad-owned passenger cars and 23 Pullmans recently built by the Pullman-Standard Car Manufacturing Company for general service in the two pairs of "City" trains which are now in service.

The normal consist of the new City of San Francisco is one baggage-dormitory car; one 48-seat chair car; one diner-kitchen car seating 32, articulated with another diner seating 64; a club-lounge car seating 35, and nine Pullman sleepers, one of which includes an observation-lounge seating 31 persons. The 14 cars in the City of Los Angeles include a baggage-dormitory car; two chair cars, seating 48 each; one cafe-lounge, seating 52; one diner, seating 56; eight Pullman sleeping cars, and one club-lounge, the "Hollywood," seating 30. None of the cars in this train is articulated. The weights of the various types of cars in these trains are shown in the table.

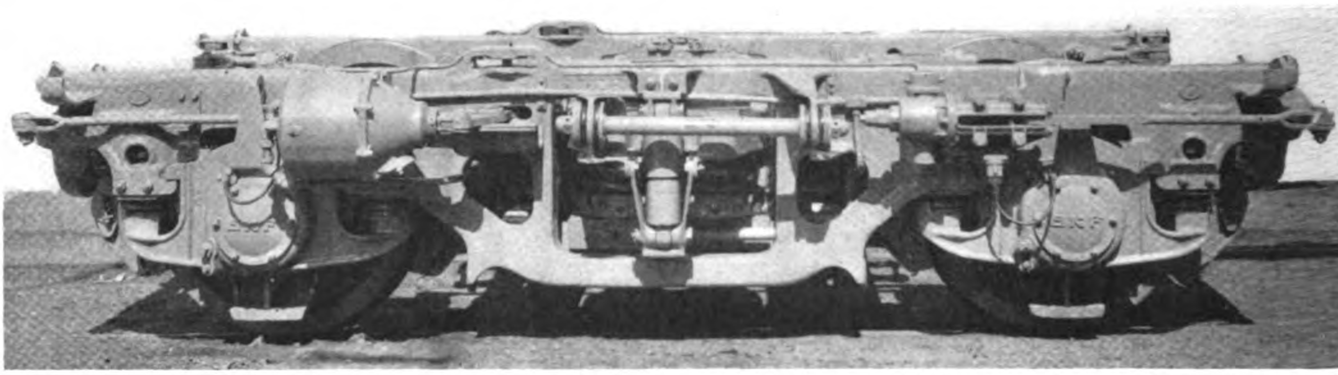
Construction Compared with Previous Trains

A comparison of the new aluminum-alloy cars with those previously built shows that the new cars are built to meet fully all requirements as set forth in the A. A. R. specifications for the construction of new passenger equipment cars, dated March 24, 1939.

All underneath equipment in the new cars is enclosed in Monel metal shrouds or bottom enclosures. The shrouds are designed with removable doors for access in servicing equipment. Such shrouding was not provided on the previous cars.

Louvered skirts projecting below the side sills have been applied between the trucks. These act with the shrouding to deflect downward the air currents under

The 6,000-hp. Diesel-electric locomotive for the "City of Los Angeles"



One of the four-wheel trucks

the cars. The previous cars had skirts, but they are not louvered. The louvered skirts are made up in short sections, 7 ft. to 8 ft. long, hinged in place so as to be readily removable when it is necessary to open the service doors of the shrouding.

The rivets on the car exteriors are countersunk and flush with the sides; button-head rivets were used on previous cars. Full-car-length anodized aluminum snap-on mouldings are applied directly above the windows and at the belt rail immediately below the windows. Cars previously built do not have such mouldings.

The exterior paint colors are yellow from eave to side sill, harbor-mist gray on the roof above the eaves and on the skirting below the side sill, with bright red striping. Previous cars are in yellow and brown, with red striping.

The end-sill and draft-gear-sill construction is now a built-up welded design, obviating the need for castings, as in previous cars. Underframe sills and cross-bearers have been redesigned and so applied as to facilitate the installation of all the underneath equipment within the shroud.

All cars are self-contained as to air-conditioning and lighting, with intercommunicating telephone systems and electric heat in addition to the conventional steam heat. The Vapor Zone thermostatically controlled steam-heating equipment is installed in the coach compartments, dining room and lounge rooms. This feature was developed since the previous cars were built.

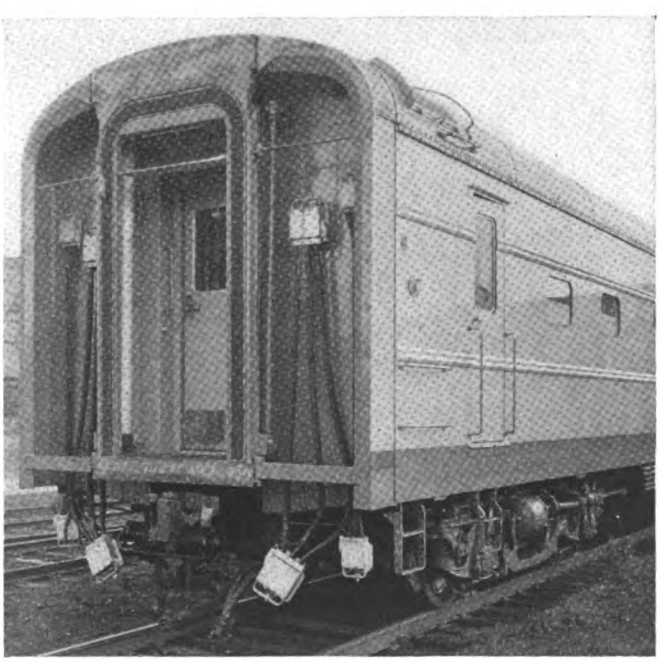
The air-brake equipment is the H. S. C. high-speed electro-pneumatic type, with a speed-governor control and appurtenances on each car. Previous equipment is H. S. C. type employing Decelakron retardation control in the locomotive cab.

Each car has its own electrical power plant consisting of a 7½-kw. Waukesha engine-driven generator unit burning propane gas, and an Exide storage battery.

Weights of Typical Individual Cars in the New City of Los Angeles Train

Type of car	Plan number	Weight of trucks, lb.	Car body weight, lb.	Total car weight, lb.
Bagg. dorm.	7443	42,100	77,600	110,700
Chair	7444	42,570	80,930	123,500
Chair	7445	42,600	80,400	123,000
Cafe-lounge	7446	42,200	90,300	132,500
Diner	7447	42,250	91,250	133,500
Club car	7451-A	42,100	87,500	129,600
Artic. diner*	7448-9	75,750	153,910	229,660†

* City of San Francisco.
† Includes two articulated car bodies, two four-wheel trucks, and one six-wheel truck weighing 32,350 lb.



The tight-lock coupler, and electric, steam, and air connections between cars

Cars of the former trains are supplied with electric power from a Diesel-electric power plant in the auxiliary baggage-dormitory car.

The main wires and cables are located in a watertight trough on top of the car roofs, instead of being applied between the sub floor and the floor, as on the previous cars.

The formerly built cars have motor-driven air-conditioning compressors which take electric power from the head-end power plant. On each new car air-conditioning equipment includes a Waukesha propane-gas engine driving a direct-connected 2-kw. generator and a 7½-ton rotary compressor. Low overall height is maintained by the use of the rotary compressor and an engine having the spark plugs and water connection mounted on the sides of the head. The generator supplies power for two fan motors in the condenser unit.

The cooling fan, instead of being mounted on a bracket at the forward end of the engine in the conventional manner, is much lower and only a few inches above the center line of the crankshaft itself. The fan is gear-driven, mounted on ball bearings. To reduce the strain on the blades when the engine is suddenly stopped, the blades themselves are held by spring tension between

two friction plates. The gears which drive the fan are helical and very wide face to make them quiet and durable.

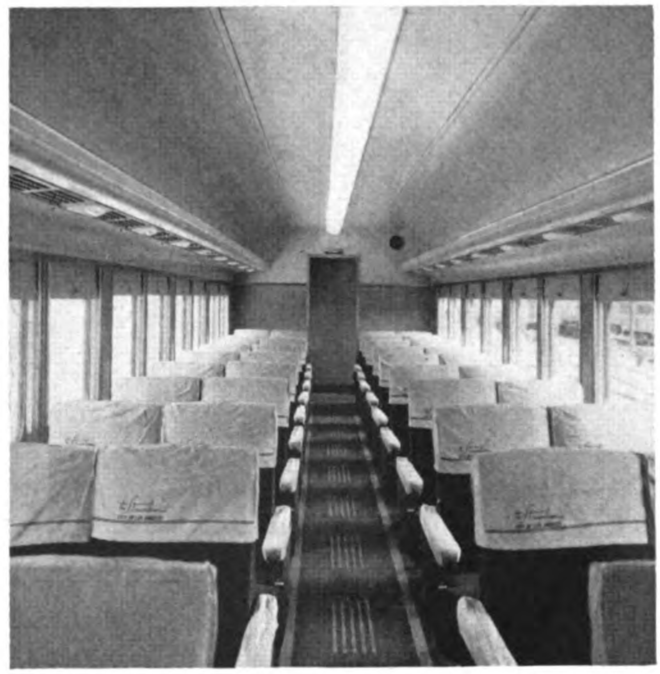
To maintain the low overall height, the reciprocating compressor used on the earlier cars was supplanted with a direct-driven, ten-vane, rotary-type compressor, also mounted on ball bearings at both ends. It has its own self-contained pressure oiling system, and except for one check valve in the return refrigerant line, there are no valves of any kind employed. Inside the compressor case made of drawn steel, the only moving parts are the rotating hub and vanes, which are held against the outer case by centrifugal force—no springs.

This compressor unit differs from the standard unit also in the fact that the condensers are not mounted on the same chassis—also a case of reducing head room—but instead are built into a separate chassis; and electrically driven cooling fans are employed to supply air.

The complete Waukesha air-cooling system includes condensers, evaporators, combination dehydrator filters, heat exchangers, expansion valves, controls and all necessary parts, each set being mounted on rubber vibration dampeners in a unit arranged to be easily withdrawn from underneath the car for inspection and repairs without disturbing fuel, water, Freon refrigerant, or electrical connections.

The overhead air ducts are aluminum, coated on the outside with Dednox 1/8 in. thick. The air outlets are aluminum Multi-Vent panels, hinged so that the entire bottom sheets of the duct may be dropped for easy cleaning. Separate filters are installed for fresh and recirculated air, the former also having a secondary filter to clean this air thoroughly before it is mixed with the recirculated air.

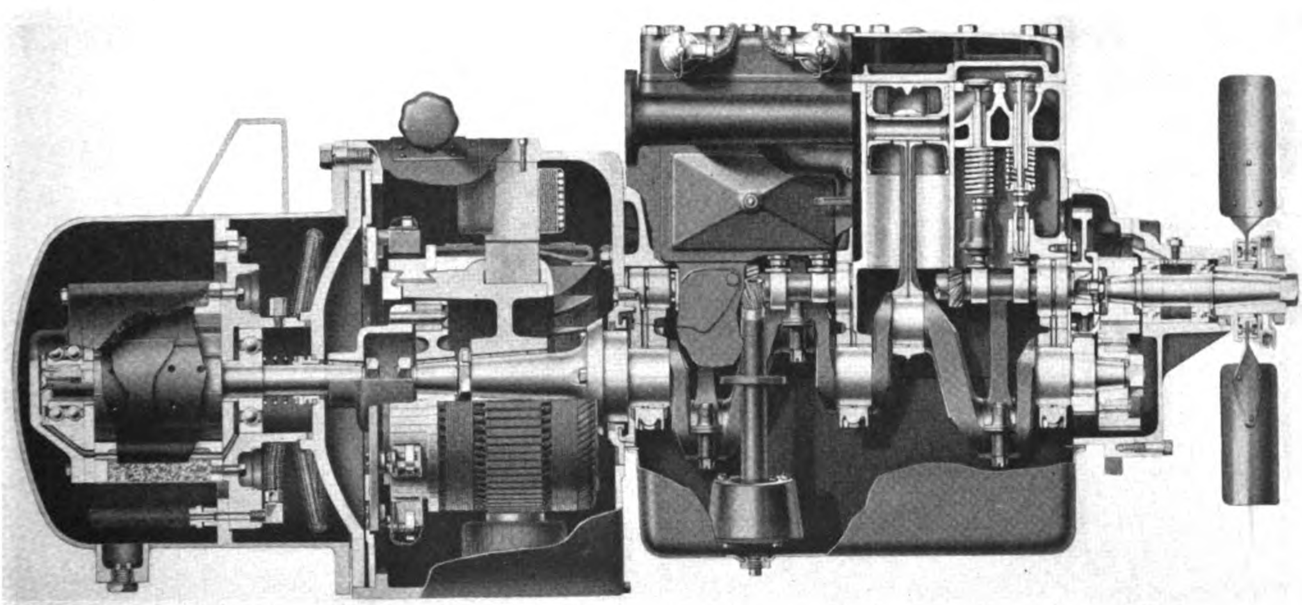
The capacity of the air-conditioning equipment is such that the temperature conditions inside the cars can be maintained at 76 deg. F. dry bulb with 63 deg. F. wet bulb when the corresponding outside temperatures are either 120 deg. F. and 70 deg. F. or 110 deg. F. and 80 deg. F. The quantity of fresh air per car is calculated on the basis of 10 cu. ft. per min. per person carried, or not less than 600 cu. ft. per min. for any type of car.



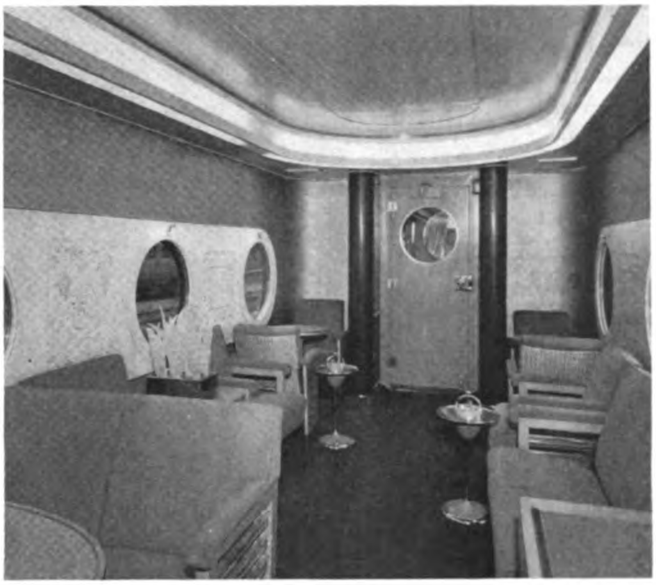
One of the chair cars in the "City of Los Angeles"

Fluorescent lighting in attractive fixtures of special design are installed in club and lounge cars, diners and chair cars. The former have Lumiline and Mazda incandescent lamps.

In addition to the radio reception utilized in the former trains, each chair car in the new trains is equipped with 10 radio pillow-type speakers, embedded in a sponge-rubber pad, which can be placed against the head, allowing only the user to hear. Receptacles are



The Waukesha air-conditioning power unit consists of a propane-gas engine, electric generator, and rotary refrigerant compressor—The generator furnishes power for separately driven condenser fans



The club car "Hollywood"

available at each seat for plugging in when desired. The hardware throughout the trains is of nickel-bronze, natural-finish.

In the two club cars, Precipitron filter units are located in the main air duct. This unit is an electrical device consisting of highly charged plates which electrostatically remove all dust passing through it and also a high percentage of the bacteria. A new type of bacteria-destroying lamp, emitting ultra-violet rays, is installed in the provision chambers of all refrigerators.

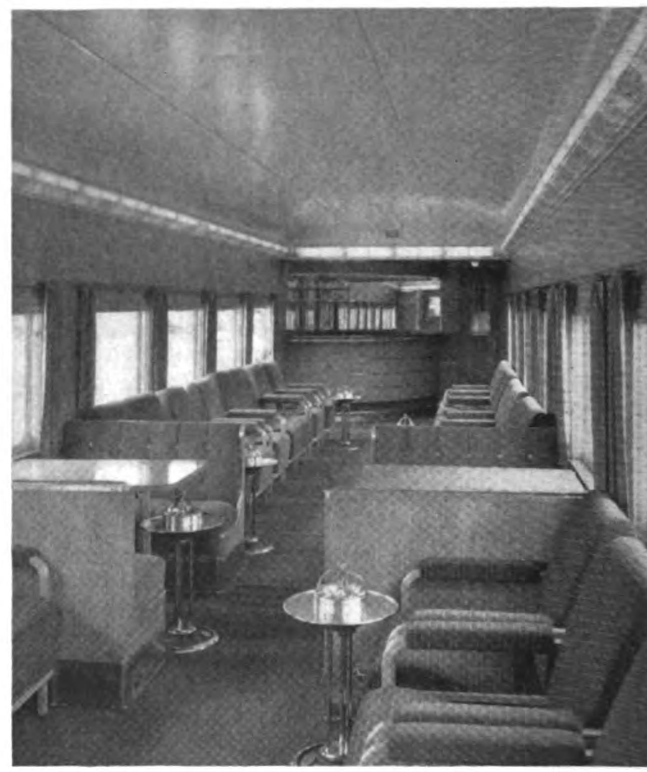
For the dining cars the Electro-Pneumatic Company's electro-pneumatic door opener and closer, operating in conjunction with the end-door lock, is installed. With this device a gentle push or pull causes the door to open or close by air pressure.

The equipment of the cars includes National tight-lock couplers and Waughmat rubber draft gears.

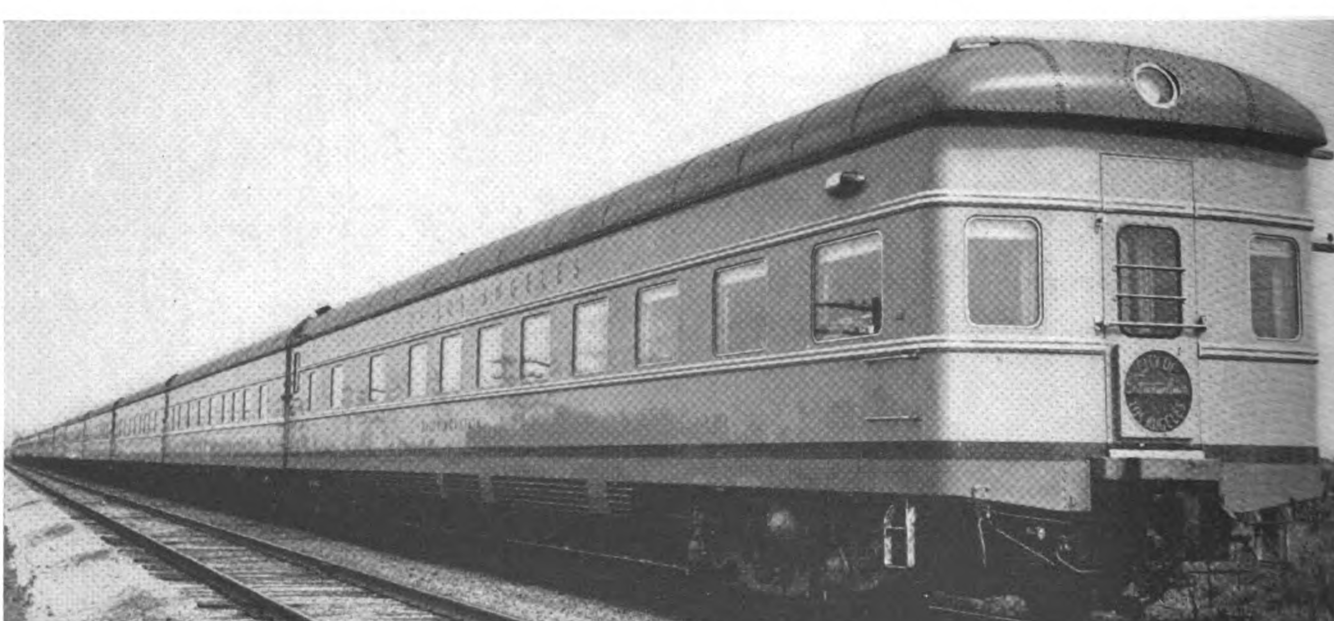
The trucks are of the same general type, but have been improved over those applied to the earlier trains, primarily by a more effective spring arrangement and the use of wide pedestal wing-type journal boxes with rubber-cushioned restraining rods and a derailment safety guide incorporated in the design. General Steel Castings truck frames and bolster are used, also stabilizing rods, rubber-cushioned pedestal liners, insulated center plates, bolster locking device, and Drews spring-type side bearings. The 36½-in. rolled-steel wheels have machine-finish treads and machined front and back rim faces.

The trucks on the City of San Francisco cars are fitted with S. K. F. roller bearings; those on the City

(*Continued on page 350*)



The club car of the "City of San Francisco"



The new "City of Los Angeles"

Research and Design of Modern

Steam Passenger Locomotives*

Part II

By P. W. Kiefer †

Freight and passenger locomotives of the 4-8-2 type—Present trends suggest the feasibility of a 4-8-4 type steam locomotive capable of delivering 6,000 cylinder horsepower

FREEDOM from lost motion and smooth-running machinery are highly desirable characteristics of this type of driving-wheel-and-axle assembly, and in order definitely to determine (1) the rotational speed at which the driving wheels actually lift from the rail, and (2) whether this speed would approach or possibly fall below the maximum recorded slipping speed of 120 m. p. h. on this class of engine, a program of slipping tests was formulated and conducted in April, 1938, on a short stretch of main-line track with a train of eight cars for trailing load. The rail was 127-lb. section on rock ballast as later described under "Track Tests, L-2d Converted."

To promote slipping, the heads of both rails were greased before each run for a distance of 230 ft. Scratch gages to measure rail deflection and movement of driving boxes with respect to frame were located at marked positions on the rail and on the locomotive. The train speed and the maximum revolving speed of the driving wheels during slips were obtained by a positively driven electrical speed indicator of the Weston generator type, and high-speed motion-picture cameras were used to record any lifting of the wheels from the rail.

Table IV—Smokebox Tests for J-1 and J-3 Locomotives at Maximum Evaporation Rate

	J-1 Class		J-3 Class	
	Original	Improved	Original	Improved
Coal fired per hour, lb....	12,300	14,500	14,700	14,200
Coal fired per sq. ft. of grate area per hr., lb...	151	178	179	173
Water evaporated per hr., lb.	76,800	85,500	84,500	92,000
Increase, per cent	...	11.30	...	8.90
Evaporation per pound of coal fired, lb.	6.24	5.89	5.76	6.48
Exhaust passageway pressure, lb. per sq. in......	22.30	21.40	25.30	24.50
Decrease, per cent	...	6.40	...	3.20
Firebox draft, in. of water	2.70	3.40	2.80	3.20
Combined efficiency, boiler and superheater (dry coal basis) per cent....	56.80	52.60	53.00	56.00
Diameter of basket-bridge exhaust nozzle, in.	6¾	7⅜	6¾	7

Four test runs were made at train speeds varying from 61 to 82 m. p. h. and with maximum slipping speeds of 123, 130, 135, and 164 m. p. h. while working steam. In the three tests at the lower speeds, there were no indications that the wheels had lifted. In the final test at 164 m. p. h., the main drivers definitely left the rail and later examination disclosed a number of very slight markings on the rails which were without significance and had no disturbing effect on the track structure requiring attention of maintenance forces.

No damage to the locomotive occurred in any of these tests and the two questions postulated were definitely answered because the rotational speed of 164 m. p. h. necessary to lift the wheels from the rail exceeded by 44 m. p. h. the highest known slipping speed of these engines.

Subsequent Improvements in Boiler Capacity and Engine Efficiency

In the year 1937, a series of standing tests was undertaken to determine the extent to which improvement in capacity and efficiency of the class J-1 and J-3 boilers and cylinders could be secured by redesign of the smokebox arrangement. The primary objectives were to increase the capacity of the boiler, accompanied by a reduction in back pressure, which would be reflected in increased cylinder horsepower and efficiency.

Table V—Smokebox Tests for J-1 and J-3 Locomotives Average Values

	J-1 Class		J-3 Class	
	Original	Improved	Original	Improved
Coal fired per hour, lb.....	7,131	7,131	7,175	7,175
Coal fired per sq. ft. of grate area per hr., lb...	87.5	87.5	87.5	87.5
Evaporation per pound of coal fired, lb.	7.87	7.90	7.89	7.82
Exhaust pressure, lb. per sq. in.	12.5	10.3	12.0	9.3
Decrease, per cent	...	17.6	...	22.5
Firebox draft, in. of water	1.8	2.2	1.6	1.4
Combined efficiency, boiler and superheater (dry coal basis), per cent...	68.5	70.0	69.4	67.8
Combustion efficiency (dry coal basis), per cent....	86.0	87.8	86.0	88.1
Diameter of basket-bridge exhaust nozzle, in.	6¾	7⅜	6¼	7

Several different smokebox arrangements were tested during these experiments, which were first conducted on J-1 No. 5224 at the Selkirk engine terminal.

Tables IV and V outline briefly the principal results‡

* Paper contributed by the Railroad Division and presented at the semi-annual meeting of The American Society of Mechanical Engineers at Kansas City, Mo., on June 17, 1941. Part I appeared in the August issue.

† Chief engineer, motive power and rolling stock, New York Central.

‡ For a description of the apparatus used and results obtained see "New York Central's Standing Locomotive Tests," *Railway Mechanical Engineer*, Part I, Feb., 1941, pp. 56-59; Part II, March, 1941, pp. 96-100.

for both the J-1 and the J-3 classes, the data being given at maximum evaporation rates and also for an average firing rate of about 7,100 lb. per hr. corresponding to 87.5 lb. of coal per hr. per sq. ft. of grate area.

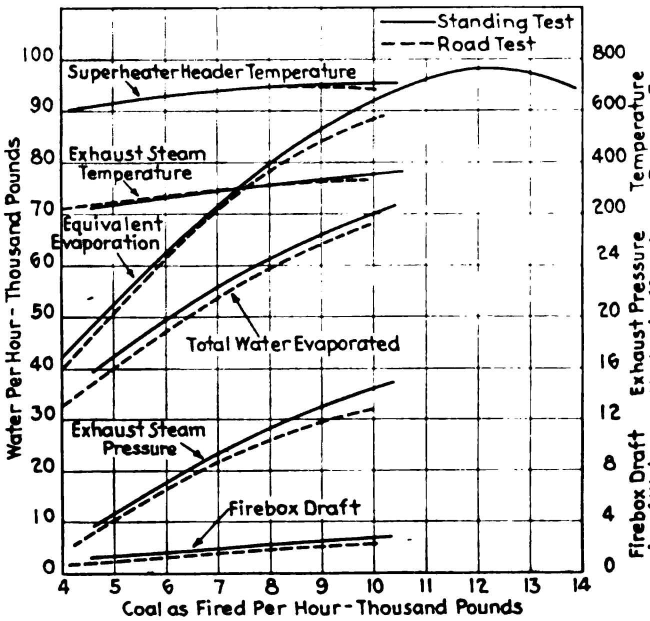


Fig. 4—Comparative results of standing tests vs. road dynamometer tests for Class J1 locomotive No. 5224 with original front end and 7⅜-in. exhaust nozzle

Fig. 4 has been prepared to show graphically the results from a road dynamometer test and a standing test for the same class J-1 locomotive with identical arrangement of smokebox, firebox, and exhaust nozzle, illustrating the close degree to which the standing tests duplicate the thermal conditions which occur when steam is used during road operations.

As a result of the experiments, installations of the improved design of front-end arrangement have been proceeding and approximately 520 engines are now equipped.

Conversion of Two 4-8-2 Locomotives for Passenger Service

With the full complement of 275 Hudson-type locomotives on the New York Central, it was found that the passenger traffic could be handled satisfactorily under normal conditions but that, during peak periods in the holiday seasons, it was necessary to use some of the older K-3 locomotives for the excess traffic. As these units were gradually retired and assigned to secondary or branch-like service, there remained an insufficient number available for this supplemental operation, and as the trains handled often demanded greater power than these engines possessed, they were not satisfactory for this purpose.

For these reasons the 4-8-2 Mohawk type freight engines, Class L-2, were occasionally used in emergency passenger service during heavy-traffic periods but were limited to 60 m. p. h. due to riding qualities and the difficulty of maintaining satisfactory running conditions with the friction-bearing driving boxes.

These engines were built during the years 1926 to 1930. When the acquisition of new freight power was lately under consideration, necessitating complete review of the design, with a number of important changes, the question arose as to whether the new design could be so arranged as to preserve the general character of freight locomotives and at the same time serve satisfactorily in passenger service during periods of peak traffic. Such additions to the freight motive power would also accomplish an increase in the available passenger power without actually involving additional units, designed especially for passenger service.

Consideration was given to the design and construction of a sample locomotive to be given a thorough test and trial but, because of the time involved and the complications usually present in an undertaking of this kind, it was decided that one or two of the L-2 class should be converted for high-speed passenger service, thus making possible early development of experience background for the design of the new engines, an order for which could then be placed without undue delay.

Two of the L-2 class, Nos. 2995 and 2998, were selected for this purpose and the following principal changes were made to provide satisfactory operation in passenger service at speeds of 80 m. p. h. and at the same time maintain suitability for freight operation equal to the L-2 class: (1) Boiler pressure increased from 225 to 250 lb. per sq. in.; (2) cylinder diameter reduced from 27 in. to 25½ in. for starting tractive force equal to the L-2; (3) lightweight reciprocating parts; (4) dynamic counterbalancing of all drivers; (5) roller bearings on engine truck, tender truck, and drivers on No. 2998; (6) roller bearings on engine truck and tender truck on No. 2995; (7) coal pushers in tender; (8) lateral-motion device on front drivers; (9) improved radial buffers between engine and tender and, (10) cast-steel pilots and drop couplers.

The weights before and after conversion were as follows:

Weight in working order, lb.:	L-2 Freight	L-2 Converted
On engine truck	59,150	65,400
On drivers	250,000	257,000
On trailing truck	61,000	62,700
Total engine	370,150	385,100

The two locomotives were released for service in August, 1939, and have been successfully handling main-line passenger trains since that time, except that one of them was removed from service for exhibition at the World's Fair throughout the 1940 season. As of December 31, 1940, a total of 200,000 miles had been accumulated on the two engines and no special difficulties of operation or maintenance have been experienced during this period of service. Table VI shows the dimensions and principal characteristics of the converted engines.

Track Tests, L-2d Converted

The weight of the two converted class L-2 locomotives had been increased about 15,000 lb. over the standard L-2 and it was essential to determine whether these engines, with 69-in. driving wheels and the modifications referred to, could be operated at the passenger-train speed of 80 m. p. h. without imposing excessive stresses on the track structure. For this purpose, track tests were conducted in September, 1939, which included one of the J-1 class as well as the two converted engines, in order to obtain comparative information, as the J-1 class, during approximately 200,000,000 miles of operation, had never been known to produce any harmful effects on the track.

Two 170-ft. test sections were used, located about one-half mile apart on the inside westbound high-speed main track of a 4-track system. Both sections are on an ascending grade of 0.315 per cent, one comprising tan-

gent track and the other a curve of 1 deg. 8 min. selected so that each test was run continuously over both sections without reduction in speed for the curve.

The rail was 127-lb. New York Central standard section laid on sound creosote-treated ties spaced about 1 ft. 8 in. center to center with canted tie plates having an outside shoulder only. The ballast was 2-in. crushed rock.

Strain gages placed in groups at 10-ft. intervals were used to measure the stresses in the rails on the outside of the rail head, underneath the rail at the center line, and on top of the outer and inner flanges. Slow-motion pictures were taken at each test section to determine the position of the crankpin for each stress recorded.

Table VI—Characteristics and Principal Dimensions of Converted L-2d Locomotives and Latest Combination Freight and Passenger Locomotive, Class L-3a

Class	L2d (conv.)	L3a
Type	4-8-2	4-8-2
Year built	1930	1940
Year converted	1939	....
Cylinders, number, diameter and stroke, in.	2—25½ x 30	2—25½ x 30
Wheels, diameter outside tires, in.:		
Driving	69	69
Max. tractive force, engine, lb.	60,100	60,100
Max. tractive force, booster, lb.	13,750	.....
Weights in working order, lb.:		
On drivers	257,000	262,000
Total engine	385,100	388,500
Tender:		
Water capacity, gal.	15,000	15,500
Fuel capacity, tons	28	43
Trucks	Six-wheel	Six-wheel
Boiler:		
Steam pressure, lb. per sq. in.	250	250
Diameter, first ring, inside, in.	82 7/16	82 7/16
Diameter, largest outside, in.	94	94
Grate area, sq. ft.	75.3	75.3
Heating surfaces, sq. ft.:		
Evaporative	4,556	4,676
Superheating	1,931	2,082
Comb. evap. and superheat.	6,487	6,758
Wheel bases, ft.-in.:		
Driving	18—0	19—0
Engine, total	42—1	43—1
Horsepower:		
Max. indicated	4,200 at 50 m.p.h.	4,400 at 55 m.p.h.
Max. drawbar	3,640 at 43 m.p.h.	3,800 at 48 m.p.h.

The results showed that up to 87 m. p. h. the maximum speed operated, the converted L-2 imposed no greater stress on the track than the J-1 and that the maximum stresses in both cases were well within permissible limits, proving that such a locomotive with 69-in. driving wheels could be operated at the same maximum speeds as the one with 79-in. drivers and substantiating the correctness of the method of balancing used for the converted L-2, which had taken into account the complete theoretical analysis. In this work much valuable assistance was rendered by the Timken Roller Bearing Company.

The ranges of comparative stresses for the two locomotives and for one of the J-3 class tested at the same time are given in Table VII.

New L-3 Combination Passenger and Freight Locomotive

On the basis of the experience gained with the two converted L-2 engines and the study that had been given to the design, with the close cooperation of The American Locomotive Company, the Superheater Company, the Timken Roller Bearing Company, and others, 50 of the L-3 class were ordered and have lately been delivered,* 25 of which are arranged for operation in either passenger or freight service, while the remaining 25 are strictly freight locomotives but having the same characteristics with respect to speed versus track structure. The combination engines are equipped with a cast-steel pilot and drop coupler, steam heat, air signal, engine-truck brake, and roller bearings on all wheels including drivers. Boosters were omitted although arrangements were made for convenient application if subsequently found desirable.

The 4-8-2 wheel arrangement was retained as it was found that for this design the required weight distribution could be secured without the use of a four-wheel trailing truck and also because it was desired to supply the largest possible tender, particularly with reference to coal capacity, without extending the over-all length of engine and tender beyond the limits of the 100-ft. turntables now in use at principal main-line terminals.

The extra large coal capacity of 43 tons was provided to increase materially the length of runs and through intensive use to obtain high monthly mileage which would be equivalent to additional locomotives.

A waterscoop of improved quick-acting design, which had recently been developed and tested, and which supplies approximately 20 per cent more water with a substantial reduction in the amount spilled, was applied.

The standard 69-in. driving wheels were retained as experience had proved this size best for high-speed main-line freight service in which the engines would be used the greater portion of the time. Provision was made, however, by increasing the driving wheel base and the over-all length, for the future application of 72-in. driving wheels, as a margin of protection for high-speed running.

For reasons beyond the scope of this paper, it was decided to use carbon steel instead of nickel steel for the boilers and, in order to conform to the desired limits of total weight and wheel loads, this necessitated using a working boiler pressure of 250 lb. per sq. in. instead of the 275 lb. per sq. in. originally planned. With this pressure and cylinders of 25½-in. diameter and 30-in. stroke, a rated starting tractive effort of 60,100 lb. was obtained, about equal to the 60,620 lb. of the L-2 class as desired.

The increase in driving wheel base permitted the use of a combustion chamber 12 in. longer than on the L-2

Table VII—Summary of Maximum Stresses; Tangent Section

Locomotive	Speed range m.p.h.	Rail	No. of stresses above 15,000 lb. per sq. in.	Five highest maximum stresses, lb. per sq. in. Average	Range
(Strain-gage located underneath the rail)					
2995 L-2d (conv.)	54.4 to 87.2 (9 runs)	Left (S)	64	21,400	22,100 to 20,900
		Right (N)	17	18,800	23,300 to 17,100
5330 J-1e	66.2 to 85.9 (5 runs)	Left (S)	34	21,200	22,600 to 19,500
		Right (N)	16	18,800	20,500 to 17,800
5435 J-3a	72 to 83.2 (4 runs)	Left (S)	21	24,200	29,100 to 20,200
		Right (N)	11	19,200	20,800 to 18,300
(Strain-gage located outside of head of rail)					
2995 L-2d (conv.)	54.5 to 87.2 (9 runs)	Left (S)	43	20,500	23,000 to 18,500
		Right (N)	26	20,200	23,400 to 18,600
5330 J-1e	66.2 to 85.9 (5 runs)	Left (S)	33	19,400	20,500 to 18,500
		Right (N)	20	22,000	27,700 to 19,100
5435 J-3a	72 to 83.2 (4 runs)	Left (S)	19	17,700	18,400 to 17,400
		Right (N)	10	19,500	22,000 to 18,400

* "New York Central Buys 50 4-8-2 Type Locomotives," *Railway Mechanical Engineer*, January, 1941, pp. 1-8, 21.

for increased firebox volume and greater combustion efficiency; greater gas area through an enlarged superheater was provided to increase the superheat temperature. An improved front end, as developed by the Selkirk tests heretofore mentioned, was installed. Particular attention was given to the proportioning of steam passages from dome to exhaust to provide free steam passage and reduce transmission losses, and the large-volume steam chest with the standard 14-in. valves was retained.

Reciprocating parts are of special lightweight design similar to those used on the two converted L-2 class, and all wheels were dynamically balanced in accordance with the theoretically correct principles established for those engines.

The following modifications were made with a resulting decrease in weight: USS Cor-Ten steel main air reservoirs; aluminum cab, running boards, cylinder and valve casings, dome and turret casings, and gage board; high-tensile-steel drop coupler; lightweight magnesia block lagging; tubes and flues to one gage tolerance and, new design lightweight valve gear.

Other special features incorporated were complete speed-recorder and cut-off selection equipment, coal pusher, Alemite grease equipment for rods and other parts, roller bearings on all axles, and lateral-motion device on front and main drivers.

The estimated drawbar pull and horsepower versus speed for the L-3 are shown by the curves included in Fig. 2. Capacity and performance tests for the L-3 are now in progress and the characteristics shown are believed to be conservative. The principal dimensions and the proportions of the converted L-2d and the new Class L-3a locomotives are shown in Table VI.

Present Thoughts on Trends of Steam-Locomotive Design Improvement for the Near Future

While this paper is confined to the subject of the conventional steam passenger locomotive, the author is fully cognizant of the rapid strides being made by other forms of motive power, their possibilities, advantages, and growing importance to the railroads for certain classes of service.

This may be illustrated by stating that on the New York Central, 127 Diesel-electric locomotives are used in intensive daily service. As early as 1924, a 60-ton 300-hp. Diesel-electric locomotive was operated in switcher and puller service in New York City territory with favorable results, followed in 1928 by a road freight and in 1929 by a road passenger locomotive. The first straight electric was introduced in 1904, and there are now 168 of various types and capacities in use on the System. Within the last 6 years, limited operating experience has been obtained with a 5,000-hp. experimental turboelectric locomotive and a 3,600-hp. Diesel-electric, both designed for high-speed main-line service, and a 5,400-hp. Diesel-electric freight locomotive.

Future development of the steam locomotive in some radically new form, such as the steam-turbine condensing or combustion type, as recently proposed, should show a substantial increase in thermal efficiency but, until the stage has been reached where such units of proved dependability in daily operation can be produced of moderate size, weight, and cost, it is the author's belief that basic lines of development should be continued by taking advantage of the possibilities for further betterment of the conventional reciprocating design without radical changes in the type of boiler or resorting to the mechanical complication of multiple expansion of steam. It should be possible now to produce a highly serviceable two-cylinder single-expansion locomotive of the 4-8-4 type at a weight per indicated horsepower closely approaching that represented by the 4-6-4 class J-3a described in this paper, capable of delivering 6,000 cylinder hp. when required.

Such a design should include the largest practicable superheater, with ample firebox volume and grate area, carefully proportioned steam passages from boiler to exhaust, and a working steam pressure probably up to 300 lb. per sq. in.

Roller bearings on all locomotive and tender axle journals and to a lesser degree in rods and motion work have resulted in increased serviceability because of freedom from heating failures. Their extended utilization should receive careful consideration.

For the future extension of steam-locomotive productive capacity, design study leading to a better proportioned and more efficient boiler is proposed. The development of a suitable drier arrangement to provide high-quality steam, taken directly from the boiler barrel, would permit elimination of the steam dome with corresponding possibilities within given weight or clearance limitations for increased diameter of barrel with improved tube and flue layouts and larger gas areas and superheater, additional firebox depth and volume, and more nearly level grates without restricting the highly important features of adequate ash-pan capacity and arrangement necessary for long locomotive runs.

Table VIII—Summary of Principal Weight and Power Characteristics for Locomotive Designs Discussed

Class	Type	Last built	Locomotive weight lb.	Maximum horsepower and speed (m.p.h.) at which attained: Cylinder	Drawbar	Weight per-horsepower, lb.: Cylinder	Drawbar
K-80	4-6-2	1912	252,500	1,700-39	1,430-35	149	177
K-2	4-6-2	1910	273,000	2,000-45	1,655-40	137	165
K-3q	4-6-2	1923	295,500	2,100-45	1,720-40	141	172
K-3r	4-6-2	1925	278,000	2,140-45	1,750-40	130	159
K-5	4-6-2	1926	302,000	3,200-54	2,530-45	94	119
J-1a No. 5200	4-6-4	1927	343,000	3,900-67	3,300-58	88	104
J-1e	4-6-4	1931	358,600	3,900-67	3,240-58	92	111
J-3	4-6-4	1937	360,000	4,725-75	3,880-65	76	93
Converted L-2	4-8-2	1930	385,100	4,200-50	3,640-43	92	106
L-3	4-8-2	1940	388,500	4,400-55	3,800-48	88	102

Design studies and performance experiments are now in progress to improve the poppet-valve arrangement of steam distribution and these efforts may result in making available for practical use the better cylinder performance in relation to power output and efficiency inherent therein, without prohibitive increase in the size and weight of the boiler.

Other interesting experiments now in operation include locomotives having four simple cylinders and two separate sets of running gear or combined within a single rigid wheel base, with which improved wheel loadings and rail effects should be obtained, together with lower dynamic forces in machinery and running-gear parts, as well as other advantages.

Ability to extend the length of locomotive runs in either freight or passenger service without stops for fuel depends to a great extent upon the size of the tender. This, in turn, may be limited by possible restrictions on over-all length. One leading western railroad now has in service back of a considerable number of modern design steam locomotives a new arrangement of tender running gear and underframe which possesses possibilities of materially increased tender capacity within given dimensional restrictions.

Discussion

R. M. Ostermann, vice president, The Superheater Company, in discussing Mr. Kiefer's paper, said in part:

"In the paragraph entitled, "Thermal Efficiency at Tender Drawbar Referred to Fuel," the author explains the circumstances which led him to compromise between thermal efficiency and practical operating advantages, and he thus exhibits the very logical view of a railroad operating man. However, the engineer sitting on the sidelines wonders whether steam locomotive designers will not eventually be forced to far-reaching modifications of the design of steam locomotives because of the pressure of the competition that the conventional steam locomotive encountered from the Diesel locomotive which has a great advantage in thermal efficiency. Steam-locomotive designers may be forced, in self-defense, in their future designs, to embody some of the principles, the application of which has produced such eminent progress in the economy of stationary power plants within the last 15 years. For instance, it is seen that the J-3 engine, at its best, works with a heat drop per pound of steam of about 160 B.t.u. It is not at all unreasonable to expect that steam locomotives may some day be worked with nearly double that heat drop in an entirely practical manner, as I have pointed out more in detail elsewhere.

"It is perfectly true that in railroad locomotives, as Mr. Kiefer points out, we are confronted with acute limitations of weight, height, width and length of structure, but it seems to me that just because of them, one should try every physical means in order to get a maximum of capacity into a given cubic space.

Frank E. Russell, mechanical engineer, Southern Pacific, in commenting on Mr. Kiefer's paper, stated that the Southern Pacific was more fortunate with respect to combustion losses and absorption efficiency because the combustion efficiency with oil fuel is high and there is only a small decrease in over-all boiler efficiency as the firing rate is increased which permits high power outputs with a moderate draft and back pressure. He considered the design of steam and exhaust passages especially important and credited much of the increase in horsepower per unit volume in the more recent locomotives to careful cylinder design having definite steam, exhaust and valve bushing area in relation to piston size. Continuing Mr. Russell said:

"Prior to 1927 apparently little attention was paid to increasing the area of exhaust passages in the cylinders in proportion to the cylinder diameter, resulting in high back pressure and low power output at high speeds. During that year we made an analysis of the proportion of exhaust passages as related to piston area, and since then all our locomotives have been built with improved exhaust passages, resulting in increased horsepower output and reduced back pressure and fuel consumption.

"In 1920 we made dynamometer tests on 2-10-2 type locomotives equipped with superheaters and determined that for superheated locomotives we should get away from saturated steam practice and that in order to obtain maximum fuel economy the cylinder diameter should be reduced and the stroke increased over the proportions normally used at that time. In 1921, when we purchased our first heavy Pacifics for service between Sparks, Nev., and Ogden, Utah, handling heavy transcontinental trains, we went to a 30-in. stroke with 25-in. cylinders, using 73-in. drivers. These locomotives were so satisfactory in passenger service, not only in high-speed hauling capacity but also in their ability to start heavy trains without taking slack, that we have continued the practice of using a relatively long stroke. Our latest 4-8-4 type locomotives have 25½-in. by 32-in. cylinders with 80-in. drivers, and we find these proportions very satisfactory for starting heavy trains and for high-speed full-power operation.

"Given a boiler designed for high-power output and high superheat, and steam and exhaust passages capable of handling the steam required for high power output, the remaining problem is that of utilizing this steam with the greatest efficiency in the cylinders. In this regard the present form of piston valve with interconnected timing of events is certainly not ideal, and I confidently look forward to the perfection of some form of valve with independent timing to obtain more adequate valve openings at high speeds and short cut-offs, together with a reduction in the present distortion of exhaust events. In this regard, the poppet valve gear mentioned in Mr. Kiefer's paper is of great interest, and I believe very promising.

"As an example of what a modern high-power steam locomotive can do, I have analyzed some of the performance records of our latest 4-8-4 type passenger locomotives purchased in 1940. These locomotives have cylinders 25½-in. by 32-in., 80-in. drivers, and carry 300 lb. per sq. in. boiler pressure. They are equipped with Type E superheaters, Worthington SA feedwater heaters and have oil lubrication on all axle bearings. These locomotives are used to handle the streamline "Daylight" trains between San Francisco and Los Angeles, Calif., which frequently have 16 cars, weighing 924 tons loaded. On these trains, the portion of the run that requires the highest power output is on the eastbound run from Camarillo to Santa Susanna, Calif., 20.9 miles, with an average opposing grade over the entire district of 0.75 per cent. Between these points the schedule speed is 62.7 m. p. h. Examining the speed recorder tapes, I find that on one seven-mile continuous stretch of compensated one per cent grade, the maximum speed maintained steadily is 55 m. p. h. with the 16-car, 924-ton "Daylight" train, which requires a calculated drawbar horsepower on level track of 4,750; the equivalent cylinder horsepower is estimated at 5,400. On other occasions these locomotives have handled the "Daylight" with 13 cars, weighing 729 tons, on the 2.2 per cent Cuesta grade, making speeds of 28 m. p. h. without a helper. On our Salt Lake division, a slightly older type of 4-8-4 locomotive is handling trains of 20 cars, weighing approximately 1,400 tons, on fast schedules."

T. V. Buckwalter, vice-president, Timken Roller Bearing Company, compared the K-80 locomotives with the J-3a class, pointing out that the improvement of from 1,430 to 3,880 drawbar horsepower was made in the short span of 33 years, the power development of 1937 being 2.71 times that of 1904 or an 8.2 per cent annual increase. Continuing, Mr. Buckwalter said, in part:

"The Hudson-type locomotive was further improved in 1937, increasing capacity in drawbar horsepower to 3,880, or 17 per cent. This, in itself, is an outstanding improvement, considering that the weight on the drivers of the J-3a is only 11,000 lb. more than that of the J-1-E, while the actual engine has only 1,400 lb. additional weight. The use of the lightweight reciprocating parts, effecting a reduction of over 50 per cent in weight, afforded an opportunity to redistribute the counterbalance, the typical practice being to distribute two-thirds to three-fourths of this reciprocating weight reduction to decreasing the counterbalance, and, therefore, the dynamic augment on the rail, and utilizing the balance to reduce nosing. Together, these have an important influence on improved riding of the locomotive and also reduce rail reaction. As Mr. Kiefer mentions, the Hudson-type locomotives have operated 200,000,000 miles with-

out a single case of rail damage attributable to this class of locomotive.

"Probably the principal improvement in steam passenger locomotives is the increase in capacity for work as measured in ton-miles per month. The average mileage of the 50 J-3's for the month of December, 1940, was 11,689 miles each. Ten of these locomotives actually made over 16,000 miles in that month. It is doubtful whether the average passenger locomotive previous to 1925 averaged more than one-third the above figure in hauling trains approximately half as heavy when the power required for air conditioning equipment is considered. This would indicate that the modern Hudson-type locomotive has six times the capacity for work as compared with the locomotive of only 15 years ago. This is a noteworthy development and affords a further indication that the replacement of the steam passenger locomotive by other forms of motive power is still a long distance in the future.

"Much thought was given to the conversion Class L-2 locomotive No. 2998. The reciprocating weight was reduced from 2,143 lb. to 1,239 lb., a reduction of 904 lb. The overbalance in the plane of the rail on the left main driver was reduced from 441 lb. to 171 lb. and the corresponding dynamic augment at diameter speed from 21,200 lb. to 8,220 lb., a reduction of 12,980 lb., or 158 per cent of the remaining dynamic augment.

"The rail reaction on the main driver at 75 m. p. h. was reduced from 28,100 to 8,200 lb. upward against the spring rigging, and from 24,000 lb. to 12,200 lb. downward against the rail. The nosing moment was reduced from 8,400,000 inch pounds to 4,000,000 inch pounds at 80 m. p. h., and the fore-and-aft shaking force from 108,000 lb. to 64,000 lb. These figures are reflected in the relatively low rail stresses at speeds up to 87 m. p. h. as indicated in the table, "Summary of Maximum Stresses," included in Mr. Kiefer's paper. The Class L-2 locomotive with 69-in. drivers, balanced as above, compares favorably with the J-1-E and J-3-A Hudson-type locomotives at high speeds with respect to lower stress in the rails and good riding qualities.

"The New York Central J-3-A and L-3-A locomotives afford an additional interesting comparison in the design of the main pedestal openings. The J-3-A driver bearing application is based on interchangeability with other types of roller bearings. The pedestal opening of 28¾ in. and pedestal clearance of 16 in. above the center line of the axle are derived from the space requirements of other roller bearings.

"The L-2-D and L-3-A pedestal opening is based on the space requirements of the taper roller bearing of the double row type having a pedestal opening of 21¾ in. and pedestal clearance of 13⅝ in. which interchanges exactly with the plain bearing requirements. In addition, there are outstanding reductions in unsprung weight and provision of more space for spring rigging with the advantages of an equal degree of reliability and greater economy in the plain bearing interchangeable layout. Most of the current locomotive construction is based on this interchangeable layout."

James Partington, manager, engineering department, American Locomotive Company, pointed out that the New York Central, to keep within weight limits on the L-3 locomotives, made the cabs, running boards and dome casings of aluminum and on the J-3 locomotives, all of the important casings were aluminum with cabs of aluminum on 40 locomotives and of USS Cor-Ten steel on 10. "Here," he said, "we have a situation where the saving of weight was urgently necessary and the use of expensive material was resorted to for a weight saving of about 2,000 lb. per locomotive.

"Twice this saving would be obtained if the boilers of these locomotives were of welded construction. I would, therefore, like to discuss briefly the welded boiler for locomotives.

"Soon after the rules for fusion welding were adopted by the Boiler Code Committee of The American Society of Mechanical Engineers, they were placed in the Code for Power Boilers. The use of these rules proved them to be safe and satisfactory, and after several years' experience, the Code Committee suggested that they be adopted for the locomotive boiler code.

"After several conferences with the Bureau of Locomotive Inspection, Interstate Commerce Commission, and largely through the efforts of the late L. F. Loree, then president of the Delaware & Hudson, permission was granted to this railroad to build and operate a locomotive with a welded boiler. This boiler was built by the American Locomotive Company to meet the requirements of the A. S. M. E. Power Boiler Code, and the locomotive was placed in freight service on the D. & H. in the fall of 1937. This welded boiler will soon have a service record of four years, and during this time very complete and thorough inspections have shown that it has a performance record of 100 per cent.

"When the I. C. C. gave its permission for the operation of this locomotive with a welded boiler, it was in response to a request sponsored by many of the leading railroads that an experimental installation be allowed. In granting this request it was stipulated that no additional welded boilers would be permitted pending a test period of five years. For the operation of additional locomotives with welded boilers, the railroads will have to secure authorization from the I. C. C. through a procedure similar to that used by the D. & H. for this first welded boiler.

"The advantages of the welded locomotive type boiler are as follows: No rivets; no overlaps; no obstructions inside or outside; no joint repairs or failures; lower upkeep expense; higher efficiency; lighter weight; easier handling; quicker washing; neater appearance, and the elimination of caustic embrittlement, which has caused rivet failures and cracked sheets in the region of both circumferential and longitudinal seams of riveted boilers. The latter, in a number of cases, has made expensive repairs necessary.

"Welding has supplanted riveting for high-pressure stationary boilers and for nearly all pressure-vessel construction. There are several hundred locomotive type welded boilers in use for power purposes in the United States, and these boilers are operating at pressures up to 350 lb. per sq. in.

"Will more welded boilers for locomotives be built? This will depend on the attitude of the railroads and the decision of the I. C. C. The locomotive builders are ready to give full assistance and cooperation in this development."

J. E. Long, western sales manager, Franklin Railway Supply Company, commented on the fact that all of the authors seemed to have one thought that stood out above all others, that is, the horsepower capacity of the motive-power unit. "Mr. Kiefer's paper showed," he said, "how the K-80 locomotives of 1904 produced 28,500 lb. tractive force and 1,700 cylinder horsepower at 39 m. p. h. while the J-3 locomotives of 1937 produced 43,440 lb. tractive force but delivered 4,725 cylinder horsepower at 75 m. p. h. This is an increase of only 52 per cent in tractive force but an increase of 178 per cent in horsepower. Weight per cylinder horsepower was reduced from 132 to 76 lb. in that time.

"The program of power development is controlled by three main factors. These are the efficiency and ca-

pacity of the boiler, the efficiency and capacity of the cylinders, and the efficiency of the machinery. While the boiler has been improved, about the only important steps taken to improve the cylinder performance are superheating and some small improvements in steam distribution but still using the sliding or piston valve."

Mr. Long continued with a description of the development of the Franklin steam distribution system and included a summary of the road tests and test plant results obtained with a Pennsylvania Pacific type passenger locomotive equipped with this steam-distribution system*. In discussing the improvement in power and in economy to be obtained from this poppet-valve system, Mr. Long pointed out the value of this development under present emergency conditions. He stated that the application of the new steam-distribution system would produce large increases in the horsepower capacity of the motive power inventory of railroads in the shortest possible time and with the least cost. Continuing, Mr. Long said, in part: "In new locomotive design to meet a definite power requirement, the application of this distribution system will result in reduced locomotive weight. On the Pennsylvania locomotive No. 5399, weight for indicated horsepower was reduced from 91 to 79 lb. On various types of locomotives which have been studied in recent months the following examples show the possible reduction in weight per horsepower:

Type	Locomotive weight, lb. per i.hp. Piston valve	Poppet valve
4-6-2	100	89
4-6-4	90	75
4-8-4	104	85
2-10-4	103	86

"The practical proof in the improvement of power output is the fact that the Pennsylvania instructions are not to double-head locomotive No. 5399 but to assign it to important and fast trains where the consist exceeds the normal locomotive rating by two cars. This is roughly an increase of 20 per cent."

C. J. Surdy, assistant to general manager, Standard Stoker Company, stated that present-day traffic, in many instances, is seasonal and during such periods there is a heavy demand for high-speed power in both passenger and freight service. He commented on the fact that few, if any, railroads can afford to hold power in reserve to meet such seasonal demands and, therefore, it is quite evident that the solution of this problem is the dual service locomotive described in Mr. Kiefer's paper.

"Of more than usual interest, said Mr. Surdy, is that portion of Mr. Kiefer's paper in which he presents his thoughts on trends of steam locomotive design and improvement for the future. With the experience on the New York Central, including the experimental use of a 5,400-hp. Diesel-electric and a 5,000-hp. turbo-electric locomotive, Mr. Kiefer's endorsement of the conventional reciprocating locomotive should be regarded by motive-power designers as a challenge. Apparently, his choice of motive power is made on the basis that nothing better has yet been offered when due consideration is given to all factors.

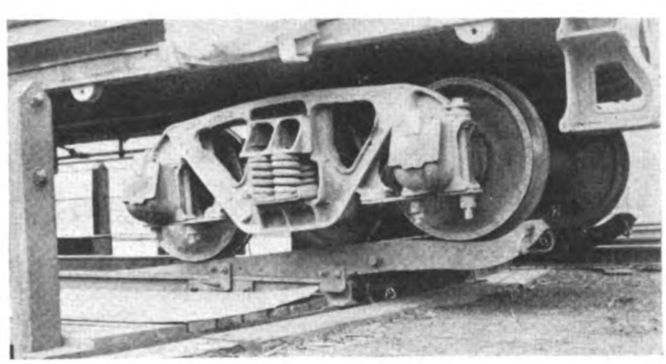
"There is much more to consider in the selection of motive power than the known advantages which are derived from more expensive power such as Diesel-electrics or turbo-electrics of the experimental type proposed in recent years. Practical railroad men must also give full consideration to the economic forces which in a considerable measure determine whether or not coal must be used as a source of power. They must take into account the effect which their use of certain kinds of coal may have on the consumer market which their railroad serves. Obviously, to take off the market coal that is desired by the consumer only results in loss of the haul to the railroad. In 1939, bituminous coal accounted for one-sixth of the total railroad freight revenue in the United States. From this it appears the railroads need the coal freight haul while the coal mine operators apparently need the railroad's fuel business to stabilize their output.

"On the premise that many railroads will continue to regard coal as a primary fuel for their motive power, it appears that sufficient incentive exists for locomotive designers to give more thought to producing a coal burning motive unit with the characteristics of the Diesel-electric. Some work of a preliminary nature has been done in this respect, but apparently the development is not complete.

"It is not within the scope of this discussion to promote a new system of motive power, but Mr. Kiefer's paper, which takes up step by step through the development of steam locomotives on the New York Central, indicates that as greater demands are made for sustained power output of steam locomotives, more study will have to be given to some arrangement for increasing the diameter of the boiler barrel which will result in improved tube and flue layouts with larger gas areas and superheater. Since the diameter of the boiler cannot in any event, with steam locomotive design trends leading toward larger drivers, be increased greatly over present dimensions, the thought of other systems of motive power naturally arises.

"With the wide experience gained through the use of the locomotive boiler of simple construction and high steam generating capacity, a logical starting point for development of a turbo-electric locomotive is present. The boiler of a New York Central Hudson type locomotive can generate a maximum of about 100,000 lb. of steam per hour. By the use of a water-tube firebox it should be possible to generate steam at a pressure in the neighborhood of 700 lb. per sq. in. This capacity would exceed the steam requirements of two or even three 2,500-hp. turbines, so that a 7,500-hp. turbo-electric locomotive, using coal as a primary source of fuel in a boiler and firebox somewhat along present conventional lines, is within the realm of possibilities."

* * *



Courtesy of Illinois Central Magazine

This extension has been applied to the turntable of the Illinois Central at Jackson, Tenn., in order to handle locomotives whose lengths are too great for the original facilities

* A description of the Franklin poppet valve gear appeared on page 349 of the September, 1939, issue of the *Railway Mechanical Engineer*. A description of the road tests and a summary of the test results made with a Pennsylvania Class K4s Pacific type locomotive, No. 5399 was published in the *Railway Mechanical Engineer*, April, 1941, page 125. A description of the series of tests on the Pennsylvania Railroad test plant at Altoona, Pa., with this same locomotive was published in the *Railway Mechanical Engineer*, May, 1941, page 169.

Four Meetings at Chicago

Conventions of coordinated associations will be held at the Hotel Sherman, September 23 and 24

FOR the fifth time, the Railway Fuel and Traveling Engineers' Association, the Car Department Officers' Association, the Master Boiler Makers' Association, and the Locomotive Maintenance Officers' Association will meet at the Hotel Sherman, Chicago, on the same two days, September 23 and 24, under arrangements made by their own coordinating committee. Although the Allied Railway Supply Association will not exhibit during the meetings this year, there has been no let-down in the preparation of the programs for the meetings by any of the four railroad associations. Full programs of the meetings appeared on pages 310 to 313, inclusive, of the August issue.

Railway Fuel and Traveling Engineers' Association

The Railway Fuel and Traveling Engineers' Association has continued its record of highly constructive service to the steam railroad industry during the past year, with many of its activities proving definitely beneficial to the railway supply industry as well. The notably successful meeting in 1940 was publicized not only in the technical press, but through the distribution of 800 copies of the Proceedings which are neatly and attractively bound and present information of value on almost every phase of locomotive operating efficiency. A revised edition of the Examination Book, issued by this association, was published and released in October, 1940, 8,000 copies being printed and 3,500 of them distributed to date. This popular book contains over 1,200 questions and answers pertaining to locomotive operation and is designed to prepare enginemen and firemen for advancement as well as new men for employment.

The association has given further attention during the year to the important question of equating oil to coal as a fuel for locomotives in order that more accurate comparisons may be made and railway managements assisted in securing more efficient locomotive operation. In addition, the association is working with the A. A. R. Accounting Division on the question of fuel used by helper locomotives being charged to the actual train and service used instead of to other service. This will make for more correct and comparable fuel performance figures. On some roads, with air-conditioning power supplied from individual front-end power plants, the fuel used for this purpose is not charged against the train, but, in the case of axle-driven and steam-actuated equipment, the considerable amount of power and hence fuel required for air-conditioning is charged against the locomotive, thus militating against accurate comparisons. Also, the association is suggesting that a more accurate and satisfactory comparison of passenger locomotive performance may be made if fuel records are kept on a 1,000 gross ton-mile basis, as well as on a basis of passenger-train car miles.

The association has made real progress in promoting the attendance of air brake supervisors at its annual meetings, a total of 21 registering at the 1940 meeting. The program was designed to appeal to these men and the air-brake papers scheduled for presentation at this year's meeting also are of exceptional value to all those interested in brake problems. These papers are expected to bring out a sizable representation of air brake supervisors.

Master Boiler Makers' Association

For sheer vitality, the Master Boiler Makers' Association has had a record which is probably unequalled by any other of the so-called minor mechanical associations. Not large in point of membership, it is a close-knit body of men, a high percentage of whom enter actively into the work of their association in one way or another at some time during the year. For many years it has exercised a position of leadership in keeping its members advised of significant developments and trends pertaining to the maintenance and performance of locomotive boilers and, what is of even more consequence, has served to keep its entire membership actively conscious of their own responsibility with respect to these developments and trends.

One of the five topics on the program of the forthcoming meeting deals with chemical treatment of feedwater. This in its various phases, has been a subject of discussion before the meetings of the association for several years. It has been dealt with in committee reports, in individual papers, and in lectures in such a way that the boiler maker foremen of American railroads are almost as thoroughly conversant with the theory behind the various problems arising from the effect of feedwater on boiler interiors as are the specialists on the subject of feedwater treatment themselves. This year the treatment of this subject is along purely practical lines.

Another forwardlooking topic on the 1941 program deals with the application of iron, steel, and alloy rivets. This topic will deal with the entire chain of problems and the sequence of procedure involved in the use of the newer materials entering into locomotive boiler construction.

Car Department Officers' Association

The Car Department Officers' Association provides a forum, with an opportunity for each individual member to express his views and ideas, and give to others the benefit of his experience, thus eliminating to some extent the necessity of trial and error and making it possible for other members to avoid costly mistakes. Next to boilermakers and possibly fuel men, car supervisors are the most loquacious among mechanical-department representatives and this is particularly true when they start discussing interchange rules.

A. A. Raymond, President,

Railway Fuel and Traveling Engineers' Association

A. J. Krueger, President,

Car Department Officers' Association

C. W. Buffington, President,

Master Boiler Makers' Association

J. C. Miller, President,

Locomotive Maintenance Officers' Association

The C. D. O. A. reflects, in large measure, the views, desires and aims of car-department supervisors throughout the country and expresses its ideas in terms which will be readily understood not only by members of the association but by the rank and file of car-department employees on all railroads. By means of a carefully prepared year book, the constructive reports and discussions presented at annual conventions, are carried to those who for various reasons are unable to attend the meetings in person.

High points of the present Fall meeting of the C. D. O. A. will unquestionably be the addresses by E. B. Hall, chief mechanical officer, Chicago & North Western, on "Co-operation Between Railroads and Departments of Railroads;" address by W. D. Beck, district manager, Car Service Division, A. A. R., on "Conservation of Equipment;" address by D. S. Ellis, chief mechanical officer, Chesapeake & Ohio, on "Better Freight-Car Maintenance." It would be difficult to select any of this year's reports for special mention as they are all on highly pertinent subjects having a direct bearing on greater efficiency in car department operation.

The General committee of the C. D. O. A. held four meetings during the year and this was an important factor in making the association an aggressive, live organization, which is attempting to function during the entire year in the interest of the railroads. Still more effective work along this line is needed. One project initiated by the association during the current year is the organized attempt to develop and make available to all members information regarding the latest labor-saving devices, jigs, fixtures and shop tools, used in car departments throughout the country.

Locomotive Maintenance Officers' Association

Through three years this organization has been held together and its activities guided by the untiring efforts of a small group of officers. It is now almost through what might be called the pioneering stage during which its possibilities as an association within a field definitely limited to the problems involved in locomotive maintenance have been carefully explored by those who have been responsible for the formation of its policies. Looking back over the past two or three years it now appears that these men have been heading in the right direction. This year's program represents a distinct and significant change in the character of the Association's work; unlike the past two years the addresses and individual papers have given way to the preparation of a group of committee reports most of which are technical. One outstanding contribution that may be expected at this year's meeting will be the report on apprenticeship which will deal with a subject of unquestioned importance to the future of the railroads—the training of an adequate supply of skilled labor.

Given the right kind of leadership in the years just ahead this Association will develop into a constructive and useful organization within its specific field.

Aluminum Alloy Streamliners

(Continued from page 340)

of Los Angeles, with Timken roller bearings. Each of the roller-bearing journal boxes is equipped with a thermal-type heat indicator, electrically connected to a common relay for operating special audible and visible signals and the train air signal valve in each car. Truck clasp-brake equipment is of the Simplex unit-cylinder type with anti-rattling device. The brake levers are of high-tensile-steel, with Ex-Cell-O case hardened and ground brake pins and bushings. The brake shoes are the straight-face type, 9 in. long, four per wheel.

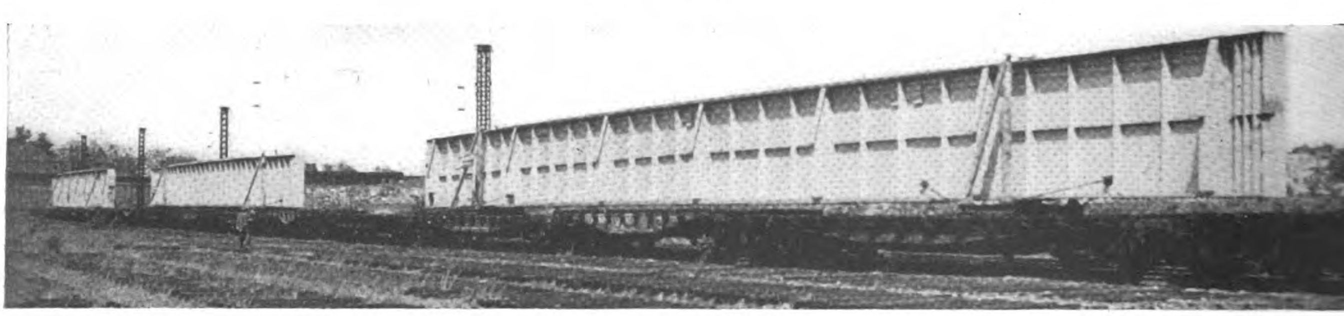
The decorative treatment as specified by the Pullman-Standard Color and Design Department, or, in the case of the car Hollywood, by Walt Kuhn, New York, and Mandel Bros., Chicago, is notable for the contrast of strong colors rather than subtle shades and blendings. Fluorescent lighting is carried around four sides of the dining and lounge rooms to suggest roominess. Mirrors, used extensively on the frieze and bulkhead panels, also give an impression of spaciousness by reflection.

In the car Hollywood, distinctly unique effects are secured. Plastics and synthetics have been used exclusively for decoration and appointments. Wall panels are constructed of Formica. The windows are of Polaroid glass and, by turning a knob, passengers can eliminate glaring sunlight without shutting off the view. Two synthetic products, Nylon and Saran, are used for furniture upholstery and coverings.

A typical color scheme is that selected for the articulated kitchen-dining car in the City of San Francisco. The basic color scheme for this car is burgundy, blue, coral and gray. The carpeting is in burgundy, with the dining chairs in gray-blue leather, draperies and window shades in coral, gray and blue, with horizontal pattern.

The wall has frieze panels of gray, pier panels finished in a light coral tone, and wainscotings of dark gray. Photomurals are used in the bulkheads at either end of the room, one pair of murals depicting the Golden Gate Bridge and the other pair showing the San Francisco-Oakland Bay Bridge. The photomurals are done in coral tones, hand colored to match with the tones of coral used in the draperies and window shades. Ceilings are pale coral, repeating the tones of the furnishings.

* * *



Three giant steel girders requiring a special train of 16 flat cars were recently shipped by rail from the Bethlehem Steel Company at Pottstown, Pa., to Baychester, N. Y., for use in connection with a new highway bridge over the six-track Hell Gate Bridge route of the New York, New Haven & Hartford at that point

EDITORIALS

Don't Expect What You Fail To Ask For

For at least the best part of the last ten years railroad repair shop supervisors and mechanical officers have been reminded frequently that advances in machine tool design have made obsolete a large part of the equipment of this character in railroad shops. The evidence of this obsolescence becomes obvious almost every time a modern machine was installed in a shop and direct comparisons were made on a production output or cost basis with machines of from 10 to 30 or 40 years old. Because of the fact that very few railroads have carried out any regular program of shop equipment replacement the average age of shop machine tools in locomotive repair shops has been steadily rising.

The development of high-speed and tungsten-carbide cutting tools paralleled the progress that has been made in machine tool design and the modern machines were largely built around the fact that these tougher tool steels were able to stand up under so much heavier cuts that greater machine-tool rigidity, increased motor horsepower and finer workmanship to produce previously unheard-of accuracy were absolute necessities in order to gain the production of which the cutting tools were capable.

It wasn't long before the machine foremen and tool supervisors in locomotive shops became conscious of the fact that the newer high-speed steels—and even in some cases the new carbide tools—had qualities that gave a new lease of life to many of the older machine tools that met certain requirements as to condition. So, the result of the introduction of these new cutting tools into the field of locomotive part machining was that they were found to be indispensable in order to get any kind of output from the older machines, and to assure that the production from the new machine was of such character and volume as to warrant the investment that had been made in the new facilities.

Now comes trouble! Because practically all munitions and defense work in which machining is involved is a high-production job it was but natural that the Office of Production Management, familiarly known as O.P.M., should issue orders putting cutting tools under priority control. Previously orders had been issued by means of which control over such basic metals as chromium and tungsten could be exercised. The present order regulating the distribution of cutting tools defines such tools as special drills, reamers, milling cutters reamers, taps and die-head chasers, among others, as coming within the scope of the order and provides, in part, that "no manufacturer or distributor may accept or make delivery under an order for cutting tools which does not bear a preference rating of A-10 or higher. . . ."

The point of this discussion is that under such conditions as we are now faced with there are two types of railroad shop supervisors with respect to their attitude toward getting things such as special cutting tools; the man who says "What's the use, we can't get it anyway," and the man who says that he recently read in the papers that the railroads have some sort of a blanket rating that will get them anything they want, so he just doesn't make any noise about it at all.

Both of these men are wrong. To date only limited blanket ratings have been issued for specific purposes and on most repair shop facilities it is still necessary to exert the utmost effort to get individual preference ratings for what is needed. In this matter of cutting tools it is more important than ever before for the locomotive shops to get their share of the special tools for machining operations. If supervisors and officers fail to ask for what they need—and ask rather insistently—it's a sure bet that from now on they won't get it.

Locomotive Lubrication

Railroads cannot give too much attention to methods of determining desirable allowances of oil to locomotive valves, cylinders and steam auxiliaries, and the best method of operating locomotives to minimize damage commonly caused by drifting, particularly at high speeds and short cut-offs, with resultant drawing of air, front-end gases and cinders into valves and cylinders, carbonizing or flashing the oil and destroying lubrication.

Adequate lubrication of locomotives is essential for economical operation, and too little lubrication results in locomotive failures, increased maintenance costs and increased fuel consumption. However, increased use of oil beyond the point necessary for complete lubrication of the moving parts is wasteful and often results in damage due to excessive carbon deposits in valves and cylinders. Many roads instruct enginemen not to close the throttle entirely until a stop is made.

The setting of mechanical lubricators to deliver the correct amount of oil to each outlet requires care and experience. One method which has proved satisfactory in practice is as follows: By trial and observation on the road, feeds are adjusted to each delivery point until the minimum amount of oil necessary for satisfactory lubrication is being delivered. In this connection, it

must be realized that, other conditions being equal, increased average speed requires an increased amount of valve oil and increased average load requires an increased amount of valve oil.

After the lubricator feeds have been set to give satisfactory lubrication for one locomotive of each class, the lubricator is then removed from the locomotive, connected up on a test rack and operated at a speed corresponding to not higher than the average speed in the class of service in which the locomotive is used. The lubricator is operated for the number of revolutions equivalent to a 20-mile run, and the output of oil from each feed measured in a glass cup graduated in liquid ounces. This information is then used as a guide in setting lubricators on other locomotives of the same class. Another method for determining the amount of oil necessary from lubricators, both mechanical and hydrostatic, involves the use of a formula, taking into account the area of frictional surface, boiler pressure, degree of superheat, number of piston strokes and speed.

Dependable force-feed or automatic lubrication of machinery is one of the most important factors in long locomotive runs and intensive utilization of motive power. The availability of the conventional-bearing locomotive is greatly increased by automatic machinery lubrication, and much concentrated attention is now being given by mechanical supervisors to piping arrangements for force-feed lubrication of machinery for both roller-bearing and conventional-bearing locomotives, as well as various types and arrangements of oil dividers or splitters.

These and other important phases of the problem of reducing locomotive friction are being considered in a constructive report on lubrication to be presented at the Fall meeting of the Railway Fuel and Traveling Engineers' Association.

Safety Features in Streamliner Operation

With substantially higher operating speeds and the ever-urgent need for safety, it is perhaps not surprising to discover how much intensive engineering development and research work have been done in the last few years to develop various devices designed to surround the operation of modern streamline passenger trains with every possible safeguard.

One important feature has been the oscillating headlight which is sometimes used to throw a light beam in the form of a figure eight, visible in clear weather a quarter of a mile on either side of the track and serving as a warning to anyone on the highways near-by or crossing the railroad right-of-way. The conventional headlight throws a powerful beam straight ahead along the track and assures visibility for the engineman. Another safety innovation is the electric hot journal alarm which gives warning in the locomotive cab if a journal bearing on any axle of the train gets hot. The alarm also causes a red light to glow in the car on which the hot journal is located, thus facilitating quick location of the defective journal by members of the train crew while the signal in the cab causes the engineman to stop the train.

A safety derailment guide flange has been developed for application on power truck pedestals in such a way that, in case of derailment, the truck is guided along the track and prevented from turning to a sharp angle which would tend to throw the car out of alinement in the train and thus subject it to possibly greater damage. The electric control, which governs the degree of brake pressure in relation to train speed so that the application of air brakes will not cause the wheels to slide, is also definitely a safety feature. An automatic water spray has also been developed which sprinkles water on the wheels to keep them cool during braking application when descending long grades. A sanding device automatically sprays sand on the rails ahead of power truck wheels in emergency applications of the brakes and can also be operated by the engineman for any normal stop if necessary.

As regards the locomotive itself, in the case of steam power, the usual safeguards for reliable safe operation are well known and widely used. For trains hauled by the newer Diesel motive power, the "dead man" control is incorporated, requiring the engineman to keep a hand or foot constantly on the control lever, otherwise causing the train to come automatically to a stop. The inter-communicating telephone system, which enables the engineman to talk with the train crew in the rear of the train, and the long-distance siren and electric gong used in regular operation, may be considered safety features. Other devices, each vitally important in the performance of their special functions, include a control which automatically stops the engines if there is any failure in the lubricating oil pressure, and a thermostatic alarm on each engine which rings a bell in the affected unit whenever there is overheating.

Low Water— And Nothing Happened!

As long as steam locomotives have operated on the railroads of this country there has been one thing which train service men have feared above all others—boiler explosions, and the resultant deaths, injuries and damage to property. It is only natural, therefore, that those who over the years have been responsible for the design and operation of locomotives should constantly be working to develop ways and means of eliminating this dangerous type of railway accident.

About 11 years ago the Baltimore & Ohio built and initiated experiments with the first of the locomotive boilers having a water tube firebox designed by its present chief of motive power, George H. Emerson. Since that time this particular type of boiler has been applied

and is being used on 13 locomotives in service on that road. It is not the purpose here to describe that type of boiler—that was done in the August, 1931, issue of *Railway Mechanical Engineer*—but to mention, and comment upon an accident that recently took place which throws considerable light upon the value of the work that has been done on the B. & O. over this 11-year period in the field of locomotive steam boiler safety.

In the original conception of the Emerson water tube firebox it was believed by its designer that, should the boiler ever be subjected to a low water condition such as causes so many disastrous explosions, certain things would take place. The design was laid down with the idea that as the level of the water in the boiler receded—a condition which in the conventional design results in exposing the crown sheet to the high firebox temperatures—it would first uncover the top rows of small boiler tubes and that the collapse of some of these tubes or the fact that one or more of them might pull away from the tube sheet, would serve, like a bursted flue, to lower firebox temperatures and to act as a safety measure in preventing the collapse of the firebox.

At 2:25 a. m. on August 12 Baltimore & Ohio locomotive No. 5600, handling a 27-car train westbound, came to a stop about 57 miles east of Cumberland, Md., because the loss in steam pressure had so far cut down the speed of the turbo-generator that reduced voltage caused the automatic train control to apply the brakes. No. 5600 is the 4-4-4-4 type locomotive that was exhibited at Atlantic City A. A. R. convention in 1937 and is one of the latest locomotives with the Emerson water tube firebox. Prior to the actual stoppage of the train the engine crew had been conscious of a steam blow which the fireman had reported to the engineman was in the firebox. In fact when the steam pressure first began to drop the steam leaking into the firebox was sufficient to blow steam and gases out into the cab when the throttle was eased off and the firedoor opened.

During the investigation of what subsequently happened the engineman stated that at no time prior to the point of the final stop did he call for a second injector to be used. This is mentioned as an indication that the engine crew had no idea that a serious low-water condition existed. Yet, when the locomotive was hauled dead to the enginehouse and an inspection made of the boiler it was found that there was definite evidence that the water level had reached a low point of 28⅜ inches below the bottom gage cock. Several small tubes and one large superheater flue had collapsed and several tubes and flues had pulled away from the flue sheet. The rear flue sheet was bulged 1 inch on the right side and ½ inch on the left side taking in an area of 41 tubes and 8 flues on each side. Not only was the bottom of the top drum exposed to the fire but the low water point was 11 inches below the bottom of the drum. Yet, the violent circulation of the water in the water tubes at the firebox sides was sufficient to protect this drum, and the top headers, from serious damage.

The above circumstances speak for themselves. The estimated expense for repairs is $350.

New Books

DIESEL ENGINEERING HANDBOOK. *1941 de Luxe Edition. Published by Diesel Publications, Inc., 192 Lexington Avenue, New York. Leatherette Cover. 521 pages. Price, $5.*

This book is another edition, in this case identified as Volume II, of a handbook for the practical Diesel engine maintenance man and operator which first appeared in 1935. Volume I under its present title appeared late in 1939 as the 1939-40 Edition. This was reviewed in the March 1940 issue of *Railway Mechanical Engineer* and dealt principally with the fundamentals of Diesel engine design and operation. Its chapters described in detail the various engine parts and accessories. Volume II is a supplementary work in which material is used that has not appeared in prior editions of this handbook. The first half of the book deals with Diesel engine economics, engine selection, power-plant building, supercharging, heat exchangers and exhaust systems. Three chapters are included on lubrication, fuel oil and injections systems and the remainder of the book discusses maintenance and drive systems. Included in this part of the book, is a chapter on Diesel-electric locomotive drives in which circuit diagrams are used to show the typical locomotive drive system.

PROCEEDINGS OF THE RAILWAY FUEL AND TRAVELING ENGINEERS' ASSOCIATION. *Published by the Association—T. Duff Smith, secretary, 327 S. La Salle Street, Chicago. 339 pages. Price, $3.*

The committee reports presented at the fourth annual meeting of the Railway Fuel and Traveling Engineers' Association held at Chicago in October, 1940, and included in the Proceedings cover Air Brakes; Coal Preparation—Mechanical Cleaning; Fuel Records and Statistics; Locomotive Firing Practice (both coal and oil); New Locomotive Economy Devices; Stationary Boiler Plants; Turbine and Condensing Locomotives, and Utilization of Motive Power. Other special papers, also presented at the meeting and included in the Proceedings, were on the Proportions of Steam Generated in Locomotive Boilers Used for Other Purposes, by E. E. Chapman, mechanical assistant, Atchison, Topeka & Santa Fe; Tests Conducted by the New York Central at Selkirk, by W. F. Collins, engineer tests, New York Central; The Road Foreman and the Diesel Locomotive, by L. W. Powell, road foreman of engines, Atchison, Topeka & Santa Fe; How Much Locomotive Fuel Can Be Saved?, by J. G. Crawford, fuel engineer, Chicago, Burlington & Quincy; Fuel Economy from the Viewpoint of the Chief Dispatcher, by T. O. Weeks, chief dispatcher-division trainmaster, Missouri Pacific. There was also included in this publication several charts and photographs taken from a motion picture made at the test plant of the New York Central at Selkirk, N. Y. showing what takes place in a locomotive firebox at high firing rates.

A 4-8-2 type locomotive rebuilt in Missouri Pacific shops

Missouri Pacific

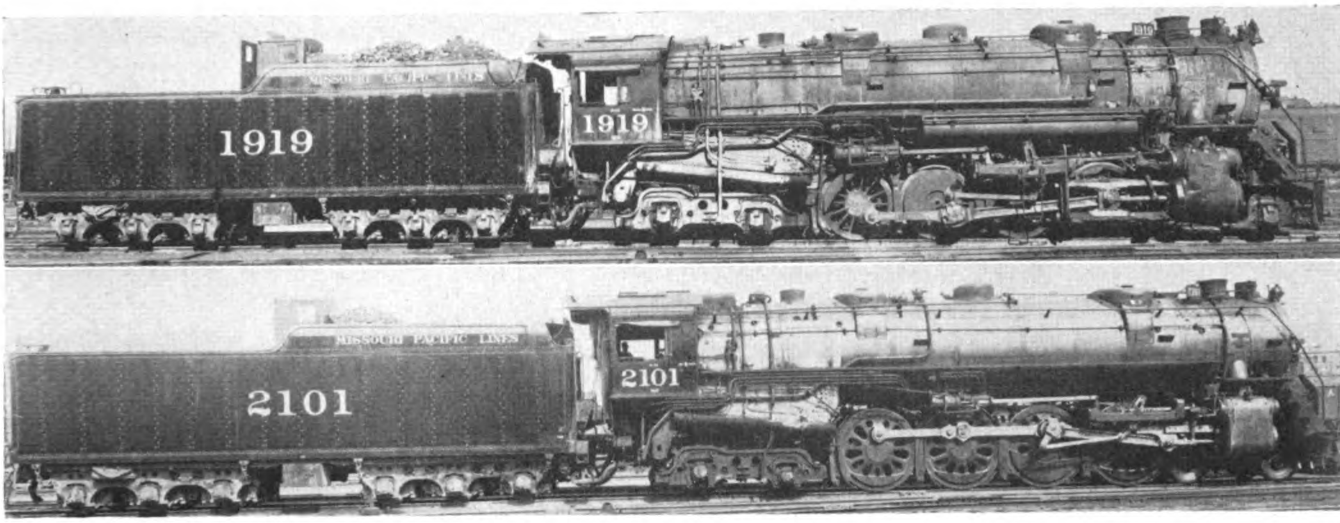
Rebuilds Locomotives

Converts seven U. S. R. A. light 4-8-2's to modern design and ten 2-8-4's to high-speed 4-8-4's in the past two years at Sedalia shops—New shop machinery played important part in keeping costs down

SINCE the summer of 1939, the Missouri Pacific has been engaged in an extensive program of rebuilding and modernizing motive power at its main locomotive shops, Sedalia, Mo., which has already effected important savings and improvements in steam locomotive performance on this railroad. Up to date, seven U. S. R. A. light Mountain-type passenger locomotives, built by the American Locomotive Company in 1919, have been converted to efficient modern high-speed locomotives with the same wheel arrangement, the original Missouri Pacific Nos. 5301-07, incl., having been changed to Nos. 5321-27, incl. This job consisted of applying almost entirely new and longer locomotive boilers, renewing the slab frames with provision for increased wheel spacing, application of new and larger driving wheels, roller bearings throughout, new valve gear and rods, and converting from coal- to oil-burning.

During the same period, ten 2-8-4 type locomotives, built by the Lima Locomotive Works in 1930, were converted into modern high-wheel 4-8-4 type units, adaptable to heavy fast service, either passenger or freight. These locomotives, originally Nos. 1901-10, incl., are now designated Nos. 2101-10, incl., and there are 15 more of the same class scheduled to be rebuilt. In this conversion job also, practically complete new boilers were constructed at the Sedalia shops, new cast steel bed frames with integral cylinders applied, also new and larger driving wheels, roller bearings, new valve gear and rods, and larger tenders installed.

Since being placed in service, the reconstructed locomotives of both classes have given an excellent performance from the point of view of reliability, high monthly mileage and the satisfactory handling of modern highspeed trains in both passenger and freight service without introducing excessive stress in either the track or equipment. A notable increase in locomotive availability and mileage have been secured. For example, during the month of June, 1941, seven locomotives of the No. 5321 class made a total of 104,530 miles in passenger service, or an average of 14,930 miles per locomotive. This may be compared with an average of 4,790 miles per locomotive per month prior to the conversion and reconstruction work, which means that the monthly mileage has been increased over three times. Similarly, with the No. 2101 class, seven locomotives accumulated 75,288 miles during the month of June, or 10,755 miles per locomotive in freight service, which may be compared with an average of 4,115 miles per



A 2-8-4 type locomotive rebuilt and modernized at Sedalia shops as a high-speed 4-8-4 type

locomotive per month previous to the conversion, this ratio of improvement being 2.61 to 1.

Changes in Principal Locomotive Dimensions

Referring to one of the tables, the comparative dimensions of these two classes of Missouri Pacific locomotives, before and after conversion, are given. In the case of the No. 5321 class, the cylinder diameter has been reduced ½ in.; driving wheel diameter increased 6 in.; total engine weight increased 34,900 lb.; boiler tubes lengthened 1½ ft., tube and flue, also superheater heating surfaces increased slightly; boiler pressure increased 25 lb.; and the tender equipped with a 5,650-gal. fuel oil tank.

The increase in driving wheel diameter from 69 in. to 75 in. for the new Baldwin disc-type wheels was made possible by the application of new slab frames which increased the rigid wheel base from 18 ft. 3 in. to 19 ft. 6 in. A General Steel Castings four-wheel engine truck and two-wheel trailing truck were installed, the wheel size of the former being increased from 33 in. to 36 in., and the latter from 43 in. to 47 in. Timken roller bearings were applied on all locomotive wheels, with A. S. F. roller-bearing units on the six-wheel tender trucks.

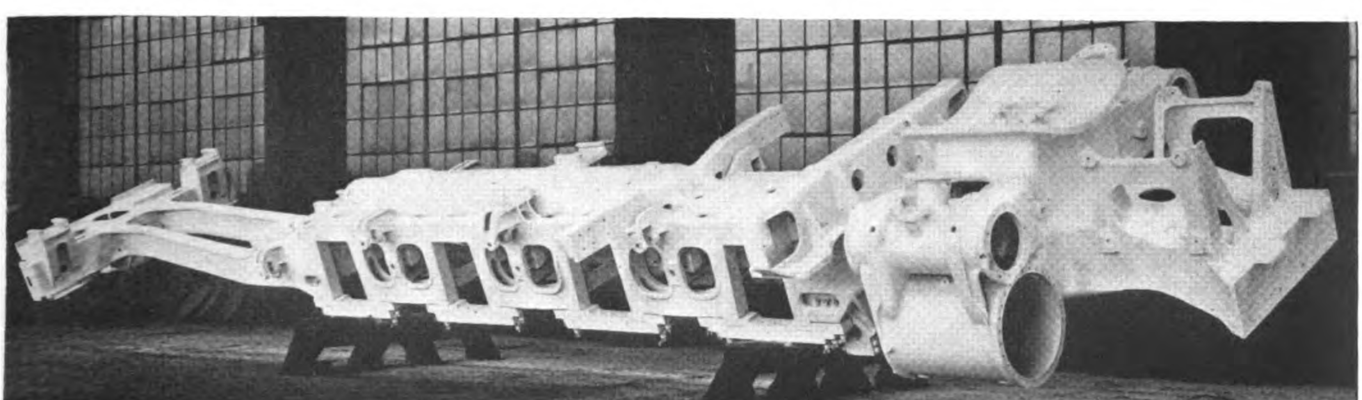
A practically complete new boiler was constructed and applied to the existing back end, the length over the flue section being increased 1 ft. 6 in. and the smoke box 2½ in. The firebox construction was strengthened to accommodate the increased boiler pressure and the Type A superheater units were converted into Type H. A. units. The stoker was removed and stored, since the new locomotive was equipped for oil burning.

The cylinders were rebushed to reduce the diameter ½ in. and new valve-chamber bushings applied, also L. F. M. lightweight steel pistons in combination with Universal sectional packing. A fire pan and brick arrangement was applied in accordance with the standard Missouri Pacific oil-burning arrangement. The right injector was replaced by a Sellers Type SR injector with Edna top boiler check. The Worthington feedwater heater was rebuilt and modernized.

New rods were made at Sedalia shops and applied, also bar-type guides, forged crossheads, and Walschaert valve gears, the latter being equipped with needle-type roller bearings. All reciprocating and revolving parts were accurately weighed and the driving wheels counterbalanced, the main wheels being cross-balanced. A new streamline pilot with retractible coupler was applied. The lagging was extended to include the smokebox and a Wellsville polished steel jacket applied on the boiler and smokebox.

Conversion of the No. 1900 to No. 2100 Class Locomotives

In the case of the No. 1900 to No. 2100 conversion, again referring to the table of comparative dimensions, the driving wheel diameter was increased 12 in.; total



Missouri Pacific 4-8-4 locomotive bed with integral cylinders and reservoir made by the General Steel Castings Corporation

Inspecting one of the Timken engine-truck roller bearings

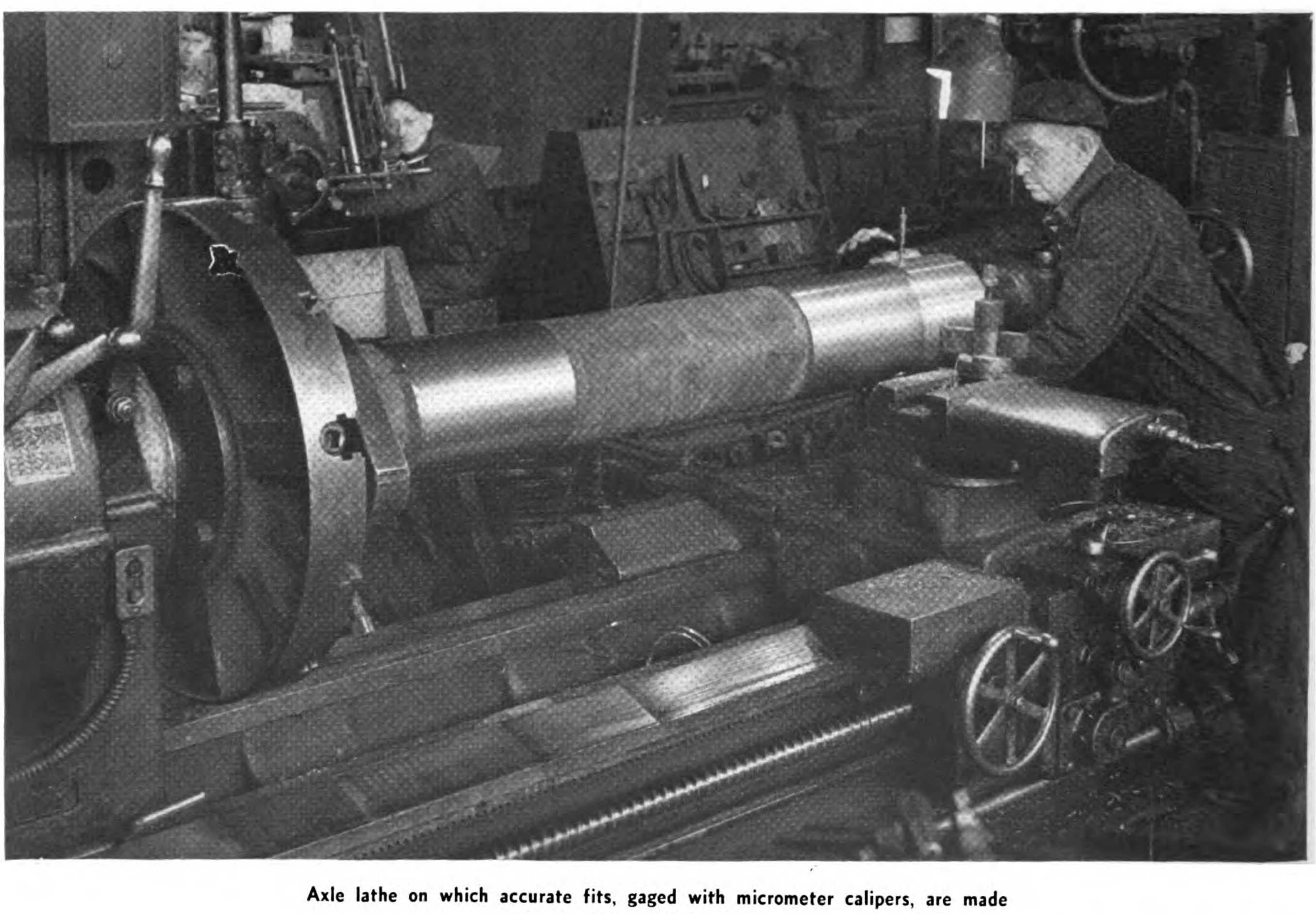
engine weight increased 33,750 lb.; firebox heating surface substantially increased by the addition of a 63-in. combustion chamber equipped with a Thermic syphon;

Comparative Dimensions of Two Missouri Pacific Locomotives Before and After Conversion

	Original No. 5301 4-8-2	Rebuilt No. 5321 4-8-2	Original No. 1901 2-8-4	Rebuilt No. 2101 4-8-4
Built by	Alco.	Mo. Pac.	Lima	Mo. Pac.
Date	1919	1939	1930	1940
Cylinder size, in.	27 by 30	26½ by 30	28 by 30	28 by 30
Valve diameter, in.	14	14	14	14
Type of valve gear	Baker	Walsch.	Walsch.	Walsch.
Stoker	B. K.	None	B. K.	B. K.
Booster	None	None	None	None
Feedwater heater	4-S	4-S2	4¼ B. L.	4¼ B. L.-2
Driving wheel diameter, in.	69	75	63	75
Loaded weights, lb.:				
Drivers	227,400	244,380	275,500	279,360
Trailer	54,000	55,720	96,900	96,590
Engine truck	53,800	70,000	39,800	70,000
Total engine	335,200	370,100	412,200	445,950
Boiler tubes:				
Number	40-216	40-213	77-204	50-190
Diameter, in.	5½-2¼	5½-2¼	2¼-3½	2¼-3½
Length, ft.	20½	22	21½	21½
Heating surface, sq. ft.:				
Firebox	323.5	323.5	256	355.7
Tubes	2,598	2,747	969.4	630
Flues	1,176	1,261	3,999	3,725
Arch tubes	14	..	15.5	15.5
Syphons	77	77	85	111
Total	4,189	4,409	5,325	4,837
Superheating surface, sq. ft.:	966	1,084	2,330	1,953
Ratio of adhesion	4.22	4.55	4.14	4.19
Steam pressure, lb.	200	225	230	250
Tractive force, lb.	53,900	53,720	66,500	66,640
Tender capacity:				
Coal, tons	18	..	20	20
Oil, gal.	..	5,650	..	..
Water, gal	15,000	15,000	17,250	17,250

and the steam pressure increased to 250 lb. per sq. in.

In rebuilding the boiler of this class of locomotive, new second and third-course barrel sheets were applied, using the original smokebox and first course applied to the original back end of the boiler with a new extension on the wrapper sheet to take the new circumferential seam at the back of the third course. The original boiler dome was re-applied.



Axle lathe on which accurate fits, gaged with micrometer calipers, are made

Assembling the Edna lubricator drive on the right side of one of the locomotives

The firebox was renewed, including a 63-in. combustion chamber, using the original mud ring, with a new outside throat sheet and braces. Nicholson thermic syphons were applied, including one in the combustion chamber. Duplex Thermic syphons were installed for test purposes in one locomotive only.

The superheater header was re-used together with the original Type E units. Owing to the application of the combustion chamber, however, four holes, right and left in the header, were plugged. Five double units were omitted at the bottom of the unit assembly and instead three single units were applied. The original length over the flue sheets was maintained, and the original smokebox arrangement, with a 22-in. stack, was not changed. The Type BK stoker was repaired.

A General Steel Castings bed frame, having integral cylinders and main reservoir, was applied. New cylinder bushings were installed, together with L. F. M. pistons in combination with Universal sectional bull rings and packing rings. The new 75-in. Boxpok driving wheels were mounted on new axles in Timken roller-bearing box assemblies, Franklin compensators and snubbers being applied to take up wear or slack on all driving boxes. The Alco lateral cushioning device was installed on the front drivers. A new General Steel Castings four-wheel engine truck was equipped with Timken roller bearings and 36-in. wheels. The four-wheel trailing truck was not changed, but Timken roller bearings were applied to new axles in the original 33-in. and 45-in. wheels. A lateral motion device was also incorporated in this truck design.

New main and side rods were installed and the original Walschaert valve gears replaced by new Walschaert gears, equipped with needle-type roller bearings. Multiple bearing guides and crossheads were applied, the guides incorporating Alco expansion clamps and the crossheads Baldwin-type pins and keys. The Worthington Type 4¼ BL feedwater heater was rebuilt into a Type 4¼ BL-2 by applying various wing-type valve service, steam cylinder and valve gear parts. An Edna 824 lubricator was applied to a bracket located on the back of the right steam chest cover with drive-arm connection to a bracket on top of the link cheek. A similar lubricator was applied on the left side back of the link support, drive being taken from the top of the link cheek. The original power reverse gear was re-applied. The lagging was extended to cover the smokebox, a Wellsville polished sheet jacket being installed complete over the back head in the cab, boiler proper, jacket bands, smokebox, sides of cylinders, steam chests and steam pipe casings.

The original 17,250-gal. tender was used and roller bearings were applied to the six-wheel trucks, which have 33-in. wheels. A Franklin Type E-2 radial buffer was applied between the locomotive and the tender, with a pocket welded to the front of the tender frame. The tender was piped for steam heat and air signals so that these locomotives may be used for passenger service, if desired. The original brakeman's cupola was maintained. Water-car piping was also maintained, but relocated to suit the steam-heat pipes.

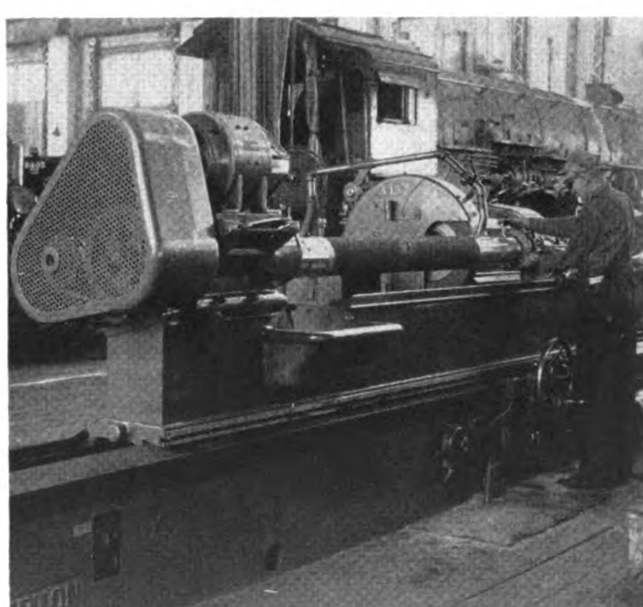
How the Work Was Handled in the Shop

From a production standpoint, this conversion work was scheduled through the Sedalia locomotive shops along with other classified repair jobs, dates being assigned for the completion of various units of work in accordance with the boiler test date. Double-shift operation was used wherever necessary, primarily on motion work and in the wheel shop. Boiler sheets were laid out and stack-cut four at a time for the first four locomotives and subsequently three at a time. The application of roller bearings necessitated greater accuracy in both wheel and axle work and also in the lining of shoes and wedges and fitting driving boxes to the frame pedes-

Man-Hours Used on Various Units of Work in Rebuilding M. P. 1901-Class Into 2101-Class Locomotives*

Unit of work	Average man-hours
Dismantling man-hours	952
Boiler first course, complete	304
Boiler second course, complete	547
Boiler third course, complete	752
Fire box made, complete	462
Fire box applied, complete	2,382
Staybolt bushings, complete	227
Outside throat sheet, complete	458
Boiler braces, blacksmith shop complete	90
Back end fit up and applied complete	476
Syphon applied, complete	153

* Figures shown are the average for the first four locomotives rebuilt.

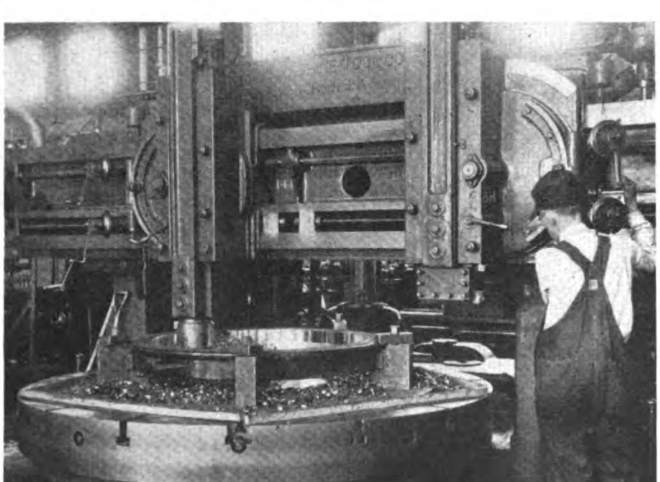


Norton grinder finishing a roller-bearing axle

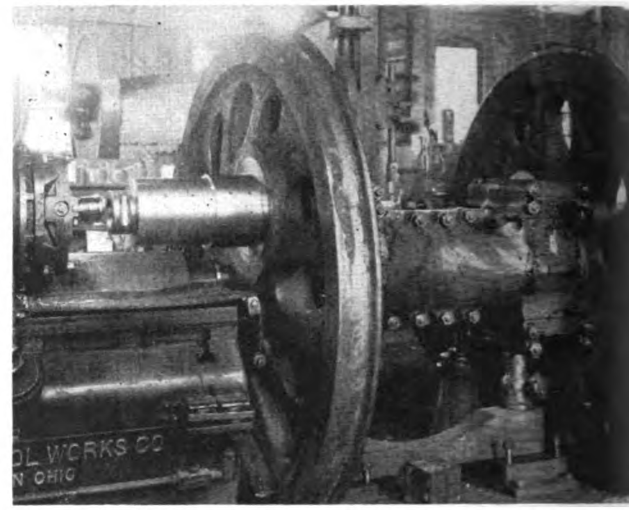
Unit of work	Average man-hours
Smoke box repaired, complete	160
Flues manufactured, complete	95
Flues applied, complete	133
Ash pan and grates repaired and applied, complete	293
Tank repaired, complete	645
Front end appliances, complete	103
Front flue sheet, made and applied	279
Running boards, made and applied	308
Foam meter box, made and applied	46
Turret casing, made and applied	59
Furnace bearer oil casings, made and applied	51
Cylinder jackets, made and applied	82
Sand dome remodeled	105
Steam pipe casings made and applied	18
Miscellaneous boiler work	240
Engine cab, complete	285
Brakeman cab, complete	8
Shoes and wedges, machined	132
Layout work	96
Link supports, machined	95
Furnace bearer shoes, machined	74
Spring rigging, forged	522
Spring rigging, machined	80
Brake rigging, forged	166
Brake rigging, machined	128
Steam and dry pipe, machined	32
Feedwater pump, machine work	14
Lateral device, machine work	7
Front cylinder heads, machined	26
Miscellaneous bolts, machined	184
Miscellaneous studs, machined	151
Cylinder bushings, machined	23
Valve bushings, machined	28
Guide clamps and guides, machined	19
Miscellaneous sawing and threading	106
Miscellaneous, machine work	131
Side and main rods, forged complete	171
Side and main rods, machined complete	653
Driver wheels complete ready to apply	808
Motion work complete, forged complete	241
Motion work complete, machined complete	888
Trailer trucks complete, ready to apply	190
Engine truck complete, ready to apply	168
Tender trucks complete, ready to apply	644
Pilot complete, applied	167
Radial buffer complete, applied	25
Mill and upholstery work	74
Blacksmith, miscellaneous	248
Jacket made and applied	535
Lagging applied	86
Piping complete	1,708
Units repaired	77
Stoker, repaired and applied	98
Water pump, repaired	52
Brass room work, complete	103
Air room work, complete	190
Locomotive carpenter, engine desk	14
Electrical work, complete	51
Erecting cab gang, all boiler mounting work	1,082
Erecting floor, complete	1,379
Paint, complete	139
Steam and dry pipes and units, applied	350
Total man-hours (including dismantling)	21,868

Division of the Work Between Major Departments

Dismantling	952
Boiler shop	8,761
Machine shop	4,691
Blacksmith shop	2,006
Erecting shop	2,811
Piping complete	1,708
Other work	939
Total	21,868



King 100-in. boring mill finishing a 44-in. tire



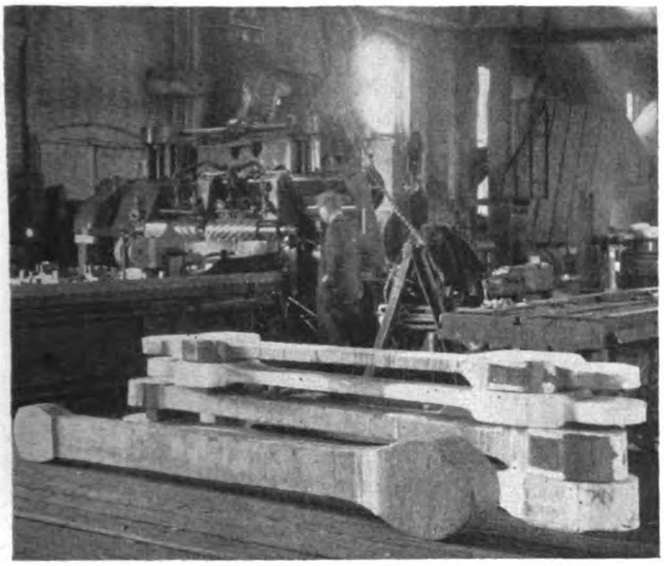
Niles quartering machine finish-rolling a crank pin in a pair of driving wheels equipped with Timken roller bearings

tal ways. Approximately 800 man-hours a day were expended on the conversion work which consisted of a large number of unit operations, as indicated in one of the tables. This table shows the average number of man-hours per job required in converting the first four No. 2101 class locomotives. A summation of these figures for the major shop department shows the following: Dismantling, 952 man-hours; boiler work, 8,761 man-hours; machine shop work, 4,691 man-hours; blacksmith shop work, 2,006 man-hours; erecting shop work, 2,811 man-hours; pipe and other work, 2,647 man-hours; total, 21,868 man-hours per locomotive.

Another table lists new machinery installed at Sedalia shops during the past two years which has proved quite helpful for the conversion work as well as for general repair operations. An examination of this table shows that the equipment includes, in addition to modern boring, turning and grinding machines, one electric welding unit, three Magnaflux inspection units and a considerable amount of crane equipment which indicates the importance of ample capacity for lifting and moving heavy material in work of this kind. The most important item of this equipment was the Whiting 25-ton crane, installed for handling boilers over the Bull riveter in the boiler shop. This 125-ton riveter has a horn 12-ft. high and, in order to handle the longer and heavier boilers while fitting the courses and driving rivets in

Principal New Tools and Equipment Recently Installed at the Sedalia Locomotive Shops of the Missouri Pacific

Size	Type of Machine
100-in.	King heavy-duty vertical boring and turning
16-in. by 40-in. by 120-in.	Norton piston-rod grinder, Type C
8-in. by 28-in.	Sundstrand automatic lathe, Type B
24-in.	Cincinnati crank shaper, heavy rapid traverse
4-ft.	Fosdick radial drill (15-in. column)
24-in. by 6-ft.	Lehmann engine lathe (swings 27 in. over ways)
No. 2	Norton universal tool and cutter grinder
¼-in. to 3-in.	Oliver twist-drill grinder and pointer
½-in. to 3-in.	Oliver twist-drill point thinning machine
16-in.	De Walt wet metal-cutting, Type GLUY
36-in.	Continental Doall contour shaping machine
½-in. to 6-in.	Mathews-Ryerson tube cutting
	Yates-American double-spindle shaper, Type N-44
	Greenlee double-spindle shaper, No. 180-B
	Ideal portable electric welding unit
	Three Magnaflux inspection units, Type ER-3
25-ton, 24-ft. span	Whiting single-motor overhead traveling crane
2-ton	Stupp Bros. jib crane (18-ft. radius)
4,000-lb.	Sprague electric hoist (floor operated)
3,000-lb.	Ingersoll-Rand pneumatic hoist with top hook
1½-ton, 16-ft. span	Conco single I-beam hand-geared crane



Locomotive driving rods are forged, heat-treated and machined at the Sedalia locomotive shops

the machine, it was necessary to install a more powerful electric crane and strengthen the crane-supporting structure. The resultant great improvement in quality and reduction in cost of fabricating the boilers more than justified the expense.

The largest machine tool installed was the King 100-in. mill, used for all large boring and turning operations. When turning tires, a cutting speed of 200 ft. per min. and a feed of .0315 in. per revolution are used, with cutting-tool tips of Firthite tantalum-carbide. These tips, $\frac{7}{16}$-in. by $\frac{3}{8}$-in. by 1 in. long, are sweated into the tool holders; the cutting edges are kept smooth and sharp; and a small chip-breaker groove is ground just back of the edge. This tool finish bores about 24 tires per grind and has a service life of about three months.

Driving and trailer tires were formerly purchased by the Missouri Pacific at an extra cost of $\frac{3}{4}$ cents per lb. for finishing. This work is now being done with the new boring mill for about $\frac{1}{10}$ cent per lb. Based on the number of new tires purchased annually for the system and which can now be machined at Sedalia shops, it is estimated that the new boring mill will effect a saving of approximately 28 per cent per year on the investment.

Another machine, especially important for the production finishing of locomotive axles, crank pins, piston rods, etc., is the Norton gap grinder which swings either 16-in. or 40-in. work, the distance between centers being 120 in. This machine replaces an old belt-driven grinder of antiquated design which was difficult to operate and secure the desired degree of accuracy and high output.

A feature of the new Norton grinder installation is the use of a floating foundation designed to insulate the machine effectively from all shop vibrations. The machine is bolted to a concrete base plate which rests on a 12-in. layer of sand, the sand being supported on and confined in a heavy concrete sub-base or foundation of box-type construction, built into the shop floor. It is estimated that this Norton grinder will save about 20 per cent per annum on its installation cost.

Similarly the new Cincinnati 24-in. crank shaper, used for shaping guide liners, crank-arm keys, wheel and axle keys, rod liners, rod brasses, frame keys and other miscellaneous small work replaces an older machine which was worn out, slow in operation, inadequate, obsolete in design and required frequent extensive repairs. This shaper, it is estimated, will save about 30 per cent per year on the investment.

The new Lehmann 24-in. engine lathe performs turning and boring operations in connection with repairs to air brakes, safety valves and injectors requiring extreme

One of the No. 5301 class locomotives in the Sedalia erecting shop

accuracy. The lathe formerly used for this work during the past 28 years was so badly worn that it could not be repaired and, even in its original condition, the machine could not be compared with a modern engine lathe from the point of view either of accuracy or productive capacity. The new engine lathe is estimated to save about 33 per cent of its total cost, installed, on boring and turning operations in the air brake room alone.

Front and back flue sheets for one of the new locomotive boilers

The Fosdick 4-ft. radial drill is used in drilling forgings manufactured in the blacksmith shop on store orders, eliminating the necessity of hauling such forgings to the machine shop for drilling. This work was formerly done on vertical drill presses built in 1905 and 1910. Both of these machines were old, slow in operation and not designed for the heavy drilling now being done in the blacksmith shop and were worn out to such an extent that they could not be economically repaired. It is expected that the new radial drill will save not far from 20 per cent of its total cost annually.

Questions and Answers On Welding Practices

(The material in this department is for the assistance of those who are interested in, or wish help on problems relating to welding practices as applied to locomotive and car maintenance. The department is open to any person who cares to submit problems for solution. All communications should bear the name and address of the writer, whose identity will not be disclosed when request is made to that effect.)

Expansion Needed For Welding Frames

Q.—Please state the amount of expansion needed for welding locomotive frames by the acetylene process.

A.—Although the amount of expansion varies with the location of the break and the pressure required to spread the frame, 1/4 in. is usually sufficient for frames up to 6 in. square. Naturally, on smaller frames and on frames where the expansion is gained with little difficulty, 3/16 in. or 7/32 in. will suffice. Care must be exercised in relieving the expansion on a frame too soon after the completion of the weld, for if the weld is still too hot, the compression will upset the weld, thus causing the frame to be too short.

Cracked Driving Wheel Rims

Q.—We are having an epidemic of cracked driving-wheel rims. Is there some method of welding these breaks successfully?

A.—An accepted method of repairing broken driving-wheel rims is as follows: If the wheel is under the locomotive, turn it until the crack is at the bottom in an accessible position. Vee the break out with a cutting torch leaving about 3/16 in. between the bottom of the V and the tire. The cut should be chipped or in some manner cleansed of all oxide. The break is then welded with a good grade of heavy coated rod and each layer thoroughly peened with an air hammer and bobbing pin. The weld should be reinforced slightly.

What To Do About Broken Binder Bolts

Q.—Frequently when applying the binders to the frame of a locomotive we break off a binder bolt. Sometimes this broken bolt is so located that it can easily be removed. On the other hand it may be one with counterbored head that requires the removal of the spring before it can be replaced. Have you any suggestions?

A.—Naturally, these bolts should be checked before the locomotive is wheeled. However, if this does happen, burn the broken bolt off an inch or so from the frame and weld on a new piece of bolt of the proper length. If this is done with the torch by an experienced operator, it will serve as well as a new bolt.

How To Repair Shop Steam Piping

Q.—In the last few years the ancient 6-in. steam piping in our shop has started to leak where the flanges are screwed onto the pipe. We have brazed the joints several times but this seems only a temporary repair for the joints start to leak again. Replacing this pipe would entail considerable expense. Is there some way of avoiding this expense?

A.—The best way of repairing leaky cast-iron flanges is to remove them entirely. Cut a 12-in. length of heavy pipe the same size as that in your steam line. The flange is now removed with a cutting torch. Do not attempt to cut to size when removing the flange, for if the steam line is hot, it will shrink or contract and leave too large an opening to be filled in with weld metal. As the contraction on all steam lines varies it is best to cut the new piece to length after the line has cooled. After the ends are trimmed, remove the slag and oxide and tack the new section in place. Then weld the new piece in place. This method eliminates a long shut-down of the steam needed for heat, etc., during the winter months.

Avoiding Fractures When Cooling

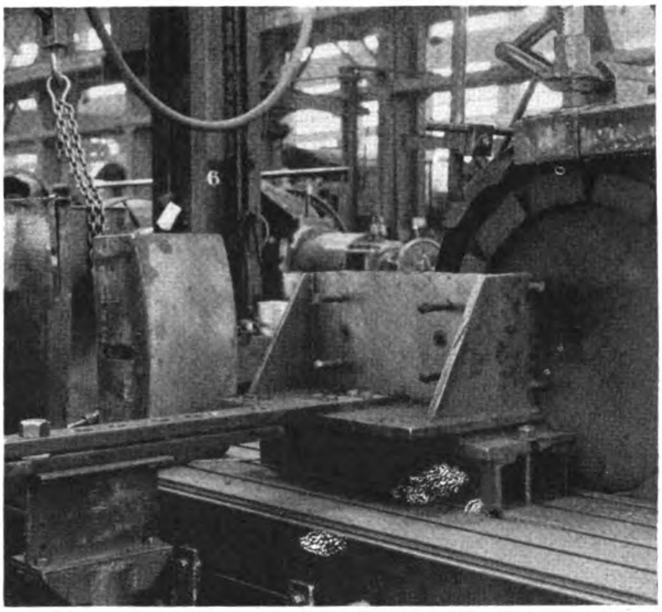
Q.—When making an electric weld the first bead often fractures as soon as it cools. How can this be avoided?

A.—This is a common happening, especially where there is no provision made for contraction. If it is impossible to preheat to overcome this cracking the only other solution is to make the first bead as heavy as possible. By laying a very heavy first bead it is possible to create strength enough in the weld to counteract

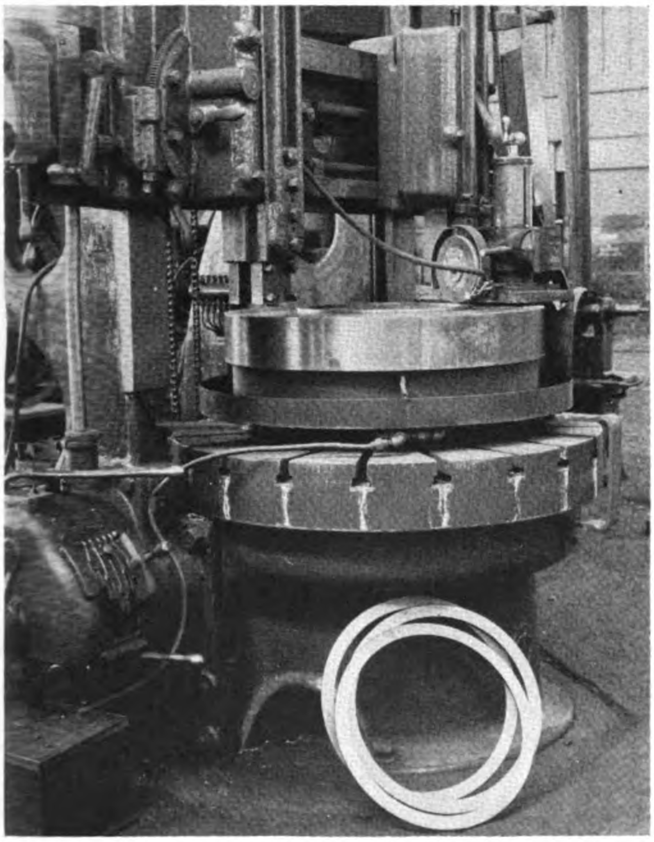
the stress and hold without fracture until successive layers of weld metal have built up the strength of the weld until there is no danger of cracking. Peening often helps to relieve some of the internal stress in a weld.

Three Interesting Grinding Jobs

Two of the three grinding jobs illustrated are due to the use of roller bearings on locomotive main drivers and the third to the use of a Franklin radial buffer between the locomotive and tender. In one it will be noted that a Timken roller-bearing housing is set up on the table of a Gray planer which has been adapted for grinding the shoe and wedge faces. The hardened spring steel liners wear about 0.016 in. before having to be trued and, without the grinding wheel, it would be difficult to machine this surface and not remove too much stock. The self-contained electric grinder rigidly secured to one of the tool posts and kept accurately true removes just enough stock to true up the pedestal ways to an accuracy of between 0.0005 and 0.001 in. The five-horsepower electric motor operates at 1,140 r. p. m. The grinding wheel is 24 in. in diameter by 2 in. wide.



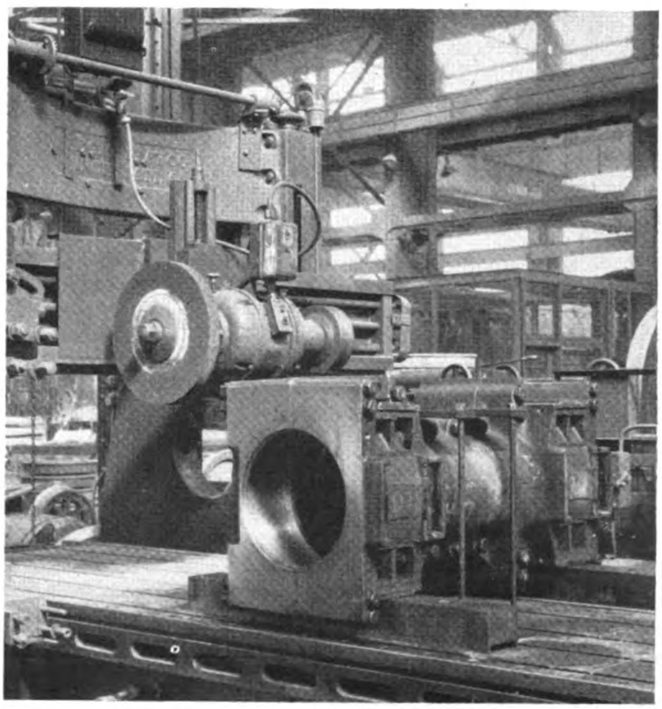
A vertical wheel surface grinder equipped with jig for truing Franklin radial-buffer chaffing plates



A 50-in. boring machine equipped with magnetic chuck and V-belt operated grinding wheel for finishing spacer rings to the required thickness

Referring to another illustration, it will be noted that a magnetic chuck is used on a Gisholt 50-in. boring mill, the tool post being equipped with a patented electric motor-driven wheel with V-belt drive. The type of spacer ring used with Timken roller bearing housings is shown at the base of the machine and by means of the magnetic chuck and accurate grinding wheel, it is possible to produce spacer rings of the desired thickness with minimum loss of time and within the desired limits of accuracy. The rings in a semi-finished state are 21-in. in outside diameter by 18-in. in inside diameter by 3/8 in. thick. The first operation is to reduce the thickness to within 0.005 in. of size with a cutting tool. The ring is then ground to finish size for thickness, with an accuracy of 0.00025 in. As held in the magnetic chuck, two stops or dowels are required to keep the ring from turning while a cutting tool is used, but during the grinding operation the use of stops or dowels is not essential.

The third illustration shows an ingenious arrangement of radial grinding attachment for a Diamond vertical sur-



A planer adapted for grinding the shoe and wedge faces of Timken roller-bearing housings

face grinder. This attachment consists of a substantial welded bracket capable of horizontal movement on a lubricated base plate attached to the bed of the grinder. The upper bracket is bolted to a radius arm which is adjustable in length to suit the diameter of the Franklin radial buffer or chafing plate. By means of suitable set screws, the chafing plate is secured in a vertical position to the face of the bracket and reciprocating movement of the grinder table moves the chafing plate back and forth past the grinding wheel in such a way as to true the cylindrical surface of the buffer casting and bring it back to the desired radius. A buffer casting is shown at left of the jig.

Boiler Patch Applied to Circumferential Seam*

The design and application of boiler patches creates many interesting problems for the reason that the defects in no two boilers are exactly alike. Boiler shell cracks are of rather common occurrence and are usually repaired by the application of a diamond patch on the outside of the shell. Such cracks invariably occur near seams, waist-sheet angle irons, or other construction which complicates the design of the reinforcement.

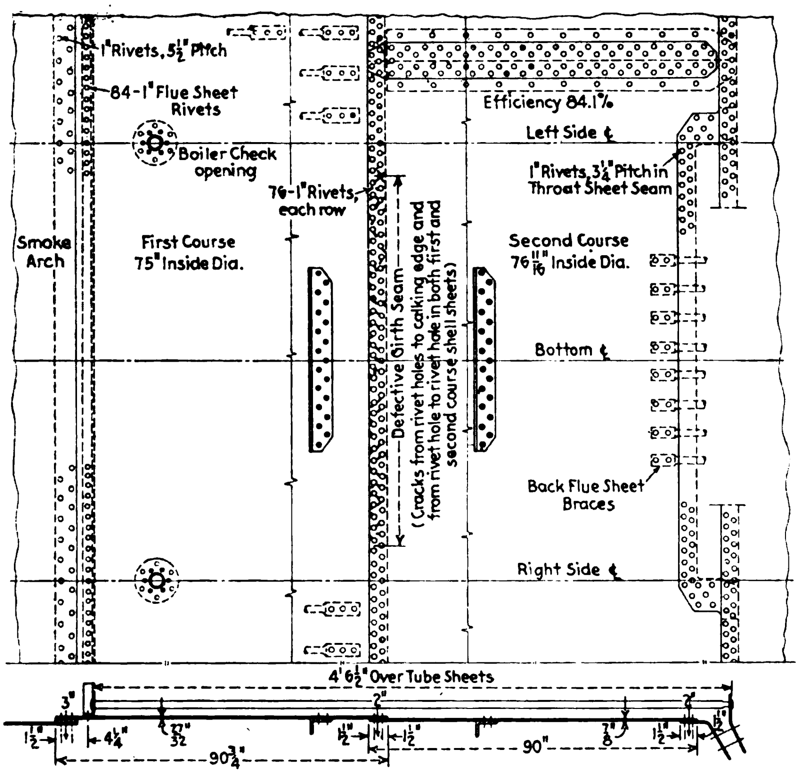
Several years ago an interesting and rather unusual case of boiler shell patching was experienced on the boilers of several Consolidation-type locomotives. The defects consisted of cracks in the circumferential seam between the first and second boiler courses, extending in some cases over practically half the circumference of the boiler. These boiler shells consisted of only two courses and the defects existed in both first and second course sheets. With the exception of the cracks in the girth seam, the boiler shells were in good condition.

The location and extent of the defects found in the boiler are shown as Fig. 1 of the attached sketch. Because of the length of the courses and the position of the longitudinal seams, neither the application of a new bottom to both the first and second courses nor the usual type of patch for minor defects in circumferential seams was desirable. It was decided to cut out the defective part of both first and second courses as shown in Fig. 2. Repairs were made by applying a new section of the second course, extending from the longitudinal seam around to the opposite center line, the section being butted up against the original shell. The new shell section was made sufficiently wide to extend over the first course where the original circumferential seam was duplicated. The connection between the old and new parts of the second course was made by means of a circumferential cover plate which also duplicated the circumferential seam. This cover plate was scarfed under the butt strap of the second course longitudinal seam, no change being made in the efficiency of this seam. This construction required considerable riveting, but made unnecessary any offsetting of sheets.

Both the new shell section and cover plate were stopped off by means of short diagonal seams, the plate efficiency of which was kept equal to or greater than the longitudinal seam efficiency. A sufficient number of rivets were used so that the shearing stress on rivets in the longitudinal seams was not exceeded. Rivet holes adjacent to the patch were used where necessary rather than new holes, and no changes were made in the stresses originally reported for this boiler.

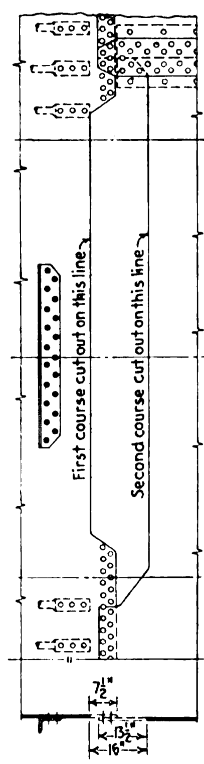
In patching boilers, the cause of the defect should be considered in order that, if possible, future trouble of the same nature will not be encountered after the boiler is repaired. In this boiler, the defects were considered

* An entry in the prize competition on boiler patches announced in the March, 1939, issue. The names of the prize winners were published in the August, 1939, issue.



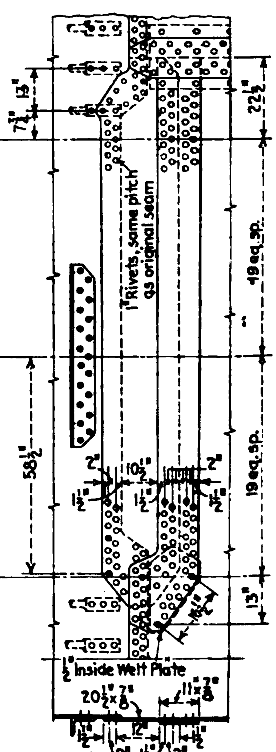
Development of boiler shell showing location and extent of defects in circumferential seam

Fig. 1



Defective portion cut out

Fig. 2



Replacement of defective circumferential seam

Fig. 3

to be caused by a water condition that had formerly existed, but which had been changed. To date no difficulty has been experienced with this boiler or others repaired in a similar manner.

Locomotive Boiler Questions and Answers

By George M. Davies

(This department is for the help of those who desire assistance on locomotive boiler problems. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless special permission is given to do so. Our readers in the boiler shop are invited to submit their problems for solution.)

Efficiency of Diagonal Row of Rivets

Q.—How is the efficiency of the diagonal row of rivets on a saw-tooth longitudinal riveted seam computed?—F. E. D.

A.—Fig. 1 illustrates a unit section of a typical saw-tooth longitudinal riveted seam. To obtain the efficiency along the diagonal row of rivets, the first step is to determine the angle that the diagonal row of rivets makes with either the longitudinal or the circumferential seams, as angles X and Y in Fig. 1. In this example the angle that the diagonal row of rivets makes with the circumferential seam (angle Y) will be considered for determining the efficiency.

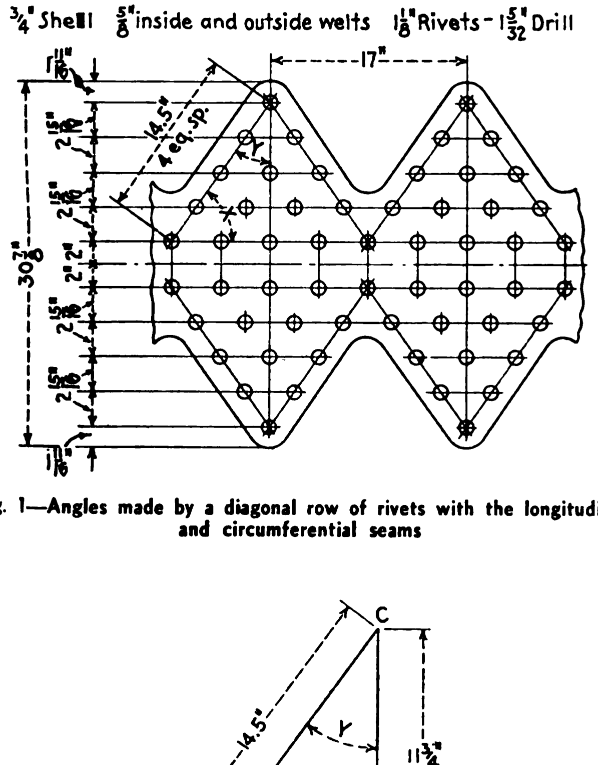


Fig. 1—Angles made by a diagonal row of rivets with the longitudinal and circumferential seams

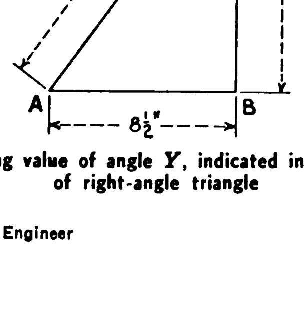


Fig. 2—Determining value of angle Y, indicated in Fig. 1, by solution of right-angle triangle

Table I—Factors for Determining the Strength of Diagonal Seams and Patches on Locomotive Boilers

Angle, deg.	Sine	Sine, squared	Cosine	Cosine, squared	Factor for strength of diagonal seams and patches: Angle measured with circumferential seam	Angle measured with longitudinal seam
20	.3420	.1170	.9397	.8830	1.717	1.047
21	.3584	.1284	.9336	.8716	1.700	1.052
22	.3746	.1403	.9272	.8597	1.678	1.057
23	.3907	.1526	.9205	.8743	1.657	1.063
24	.4067	.1654	.9135	.8345	1.635	1.068
25	.4226	.1786	.9063	.8214	1.614	1.074
26	.4384	.1922	.8988	.8078	1.594	1.079
27	.4540	.2061	.8910	.7939	1.572	1.087
28	.4695	.2204	.8829	.7795	1.552	1.094
29	.4848	.2350	.8746	.7649	1.531	1.102
30	.5000	.2500	.8660	.7499	1.510	1.109
31	.5150	.2652	.8572	.7348	1.492	1.117
32	.5299	.2808	.8480	.7191	1.474	1.126
33	.5446	.2966	.8387	.7034	1.455	1.134
34	.5592	.3127	.8290	.6872	1.437	1.141
35	.5736	.3290	.8192	.6711	1.419	1.152
36	.5878	.3455	.8090	.6545	1.401	1.162
37	.6018	.3622	.7986	.6378	1.385	1.171
38	.6157	.3791	.7880	.6209	1.368	1.182
39	.6293	.3960	.7771	.6039	1.353	1.192
40	.6428	.4132	.7660	.5868	1.340	1.204
41	.6561	.4305	.7547	.5696	1.322	1.215
42	.6691	.4477	.7431	.5522	1.306	1.227
43	.6820	.4651	.7314	.5349	1.292	1.239
44	.6947	.4826	.7193	.5174	1.278	1.252
45	.7071	.5000	.7071	.5000	1.264	1.264
46	.7193	.5174	.6947	.4826	1.252	1.278
47	.7314	.5349	.6820	.4651	1.239	1.292
48	.7431	.5522	.6691	.4477	1.227	1.306
49	.7547	.5696	.6561	.4305	1.215	1.322
50	.7660	.5868	.6428	.4132	1.204	1.340
51	.7771	.6039	.6293	.3960	1.192	1.353
52	.7880	.6209	.6157	.3791	1.182	1.368
53	.7986	.6378	.6018	.3622	1.171	1.385
54	.8090	.6545	.5878	.3455	1.162	1.401
55	.8192	.6711	.5736	.3290	1.152	1.419
56	.8290	.6872	.5592	.3127	1.141	1.437
57	.8387	.7034	.5446	.2966	1.134	1.455
58	.8480	.7191	.5299	.2808	1.126	1.474
59	.8572	.7348	.5150	.2652	1.117	1.492
60	.8660	.7499	.5000	.2500	1.109	1.510
61	.8746	.7649	.4848	.2350	1.102	1.531
62	.8829	.7795	.4696	.2204	1.094	1.552
63	.8910	.7939	.4540	.2061	1.087	1.572
64	.8988	.8078	.4384	.1922	1.079	1.594
65	.9063	.8214	.4226	.1786	1.074	1.614
66	.9135	.8345	.4067	.1654	1.068	1.635
67	.9205	.8473	.3907	.1526	1.063	1.657
68	.9272	.8597	.3746	.1403	1.057	1.678
69	.9336	.8716	.3584	.1284	1.052	1.700
70	.9397	.8830	.3420	.1170	1.047	1.717

Rule—To find strength of joint of patch, when at an angle with the longitudinal or circumferential seam multiply strength of corresponding seam or patch by factor in table opposite desired angle.
Formulas for determining factors =

$$2 \div \sqrt{1 + 3 \text{ sine}^2 Y} \text{ and } 2 \div \sqrt{1 + 3 \cos^2 X}$$

Referring to Fig. 2, A-B-C is a right-angle triangle, in which AB equals 8½ in. and BC equals 11¾ in. These dimensions are obtained from the seam in Fig. 1, where AB would equal one-half the pitch of the outside row of rivets, and BC, the total circumferential spacing of the first five rows of rivets or $2^{15}/_{16}$ in. × 4 = 11¾ in.

To find the length of AC in Fig. 2:

$$AC = \sqrt{AB^2 + BC^2}$$
$$AC = \sqrt{(8.5)^2 + (11\tfrac{3}{4})^2}$$
$$AC = 14.5 \text{ in.}$$

The sine of angle Y is equal to AB divided by AC:

$$\text{Sine angle } Y = \frac{8.5}{14.5} = .5862$$

Referring to standard tables of natural trigonometrical functions we find that .5862 is the sine of a 35-deg. 53-min. or 36-deg. angle.

The efficiency of the rivets in the diagonal row is now obtained from the following formula:

$$E = \frac{(L - 4D) \times TS \times t}{L \times TS \times t} \times K$$

Where

E = Efficiency of diagonal row of rivets.
L = Length of diagonal row of rivets = 14.5 in.
D = Diameter of rivets after driving = $1\frac{5}{32}$ in.
TS = Tensile strength of plate = 55,000 lb.
t = Thickness of shell plate = $\frac{3}{4}$ in.
K = Constant allowed for diagonal row of rivets, taken from Table I = 1.401.

Substituting in the formula we have:

$$E = \frac{[14.5 - (4 \times 1.15625)] \times 55{,}000 \times .75}{14.5 \times 55{,}000 \times .75} \times 1.401$$

$$E = \frac{407{,}343}{598{,}125} \times 1.401$$

$$E = 95.4 \text{ per cent}$$

Breaking in Locomotives At San Bernardino Shops

At the Atchison, Topeka & Santa Fe locomotive shops, San Bernardino, Cal., locomotives are turned over to the operating department already partially "broken in" for revenue service. The breaking-in operation is performed as soon as a locomotive comes off the shop firing line, when it is placed on a well oiled slip track and operated at relatively slow speeds for several hours until the main journals have reached a steady temperature. The locomotive is then stopped over an outside pit, the wedges adjusted, minor finishing operations completed and any defects which may be found corrected. Freight locomotives are subsequently operated in helper service and passenger locomotives in secondary service before being placed on call for heavy fast runs with important trains.

While a locomotive is on the firing line, the tank is coupled and the locomotive fired up, the pops being set if necessary, the brakes tested and adjusted, all leaky joints tightened, and injectors, lubricators and air pumps tested. The locomotive then moves to the slip track, with all wedges free, rod grease cups filled, lubricators filled, all driving-box shoes and wedges, hubs, journals, etc., properly lubricated. The oil rigging is applied in two parts. One connects to the oil-tank drain line, which leads to a crossover pipe over the right and left rail, where a trickle of fuel oil is allowed to drip on each rail in about match size drops. The second part is connected to the tank heater drain pipe and supplies steam to keep the oil fluid and flowing freely to the rail even in the coldest weather. A low-gravity oil is used.

The slip track consists of 900 ft. of rail, approximately .07 upgrade, west from the shop, with a 55-ft. pit opposite the shop, as shown in the illustration. The locomotive is slipped westbound after making preliminary trip to oil the track. The slipping speed of 12 to 15 m.p.h. is used to warm up the bearings, equivalent to one mile up and back for the first hour. The bearing temperatures are then tried with a Pyro-prod, and usually show from 100 to 120 deg. F., or 15 to 20 deg. above the atmospheric temperature. During the second hour, at a slipping speed of 20 m.p.h. the temperature increases from 15 to 25 deg., and the third hour at 30 m.p.h., the temperature begins to decrease. Locomotives receiving Class 3 repairs are slipped for five hours and Class 4 and 5 repairs for three hours. Wedges on the locomotives are set after $1\frac{1}{2}$ hr. slipping, using a ratchet wrench. In 1940, 497 locomotives had their wedges set up in this manner without a case of hot-box trouble being subsequently reported when the locomotives went into service.

Occasionally a locomotive journal runs warm on the slip track, due to poor fitting wedges or a sticky cellar screen, but this happens not over once or twice a year and is quickly corrected. Operation on the slip track also breaks in the driving rods, valve motion parts and cylinder and valve packing, all of which are watched closely and checked to make sure they are receiving proper lubrication. High operating speeds are not attempted on the slip track as it would cause excessive wear of the rails and introduce some hazard. The locomotive is stopped at the end of each run with cylinder compression controlled by operation of the reverse lever. Sand pipes are plugged with waste.

Santa Fe locomotive on the slip-track pit outside the San Bernardino shops

N. Billerica Wheel Shop

In 1939 it became evident to those responsible for mechanical department maintenance operations on the Boston & Maine that the practice of servicing and repairing wheels and axles at different points on the system could no longer produce the desired results, either from the standpoint of output or of cost. A thorough study was made of current and future requirements of wheels and axles and a new wheel shop was projected upon the underlying principle of concentrating all of the work for the entire system at a point where modern and efficient facilities could be installed and the standards of workmanship properly controlled. As a result, the new shop was located at North Billerica, Mass., where the company's system locomotive shop is situated. The new wheel shop was completed and placed in operation in 1940 and has now passed through the "break-in" period to regular full-time production.

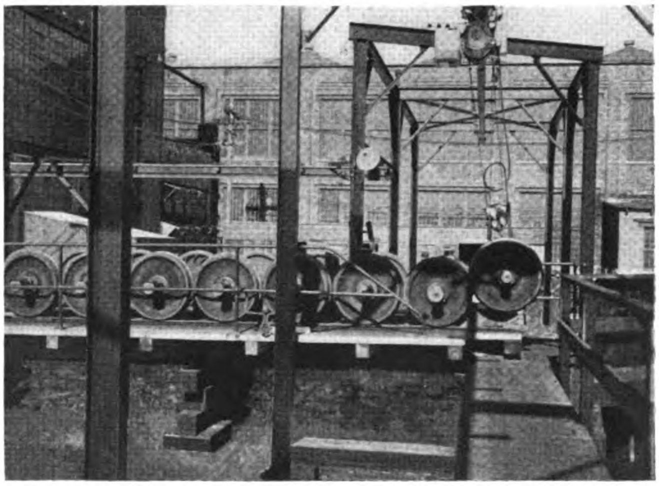
The wheel shop occupies a corner section of the annex building of the main locomotive shop approximately 90 ft. by 200 ft. The arrangement of the facilities is shown in the drawing on page 366. The wheel shop is adjacent to the section in the locomotive shop where the tenders are unwheeled and it is well situated with respect to tracks for the incoming and outgoing wheel sets whether they arrive and depart in railroad cars from outlying points or originate at North Billerica shop.

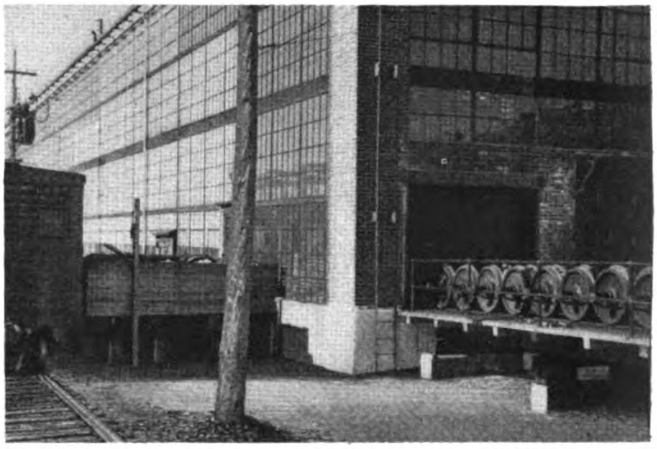
For convenience in referring to the several facilities in the following description, numerals from one up are used to designate standard-gage tracks; numerals from 101 up, to designate machine tools, and letters, such as A, B, etc., to designate other facilities.

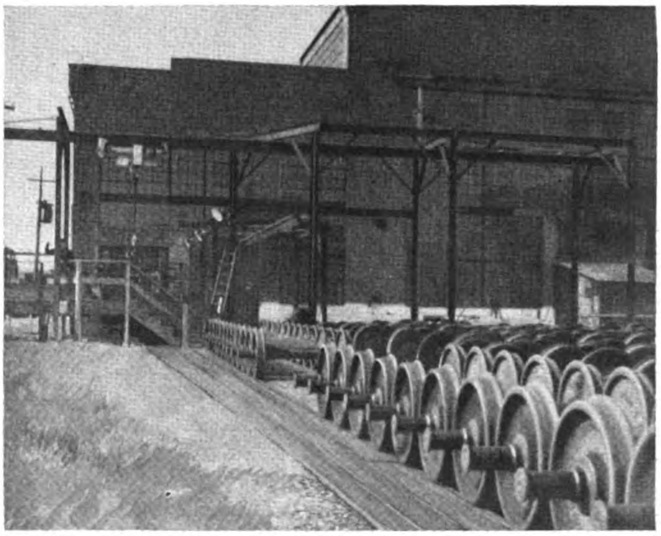
The principal service tracks, identified by Nos. 1 to 4, inclusive, all provide access to the wheel shop area from yard tracks. These tracks are interconnected within the shop yard area by conveniently located crossovers. Track 5 is a stub track in the shop in front of the journal lathes and Track 6 is a transverse shop track of standard gage which goes through the entire shop from the wheel storage area 7 on the south side of the wheel shop to the material storage area between the main longitudinal locomotive machine and erecting shop and the storehouse and office building.

Perhaps the simplest method of describing these facilities and their use is to follow the course of wheel sets through the shop. In general, the problem of the wheel shop is to handle (1) mounted wheel sets which must be demounted, axles refinished, and mounted with new chilled-iron or steel wheels; (2) mounted wheel sets which must have wheel treads returned with or without axle-machining operations; (3) mounted wheel sets on which only the journals need refinishing, and (4) the make-up of new wheel sets to meet additional requirements of service or to replace wheels and axles that have reached condemning limits and must, of necessity, be scrapped.

Wheel sets, such as those in Group 1, arrive in greater quantity on cars from outlying points. The cars are spotted by the car puller at platform *A* where the wheels are unloaded by a Shepard-Niles 4,000-lb. capacity electric monorail hoist and set down on the track at the end of inclined runway *B* which leads into the shop and to

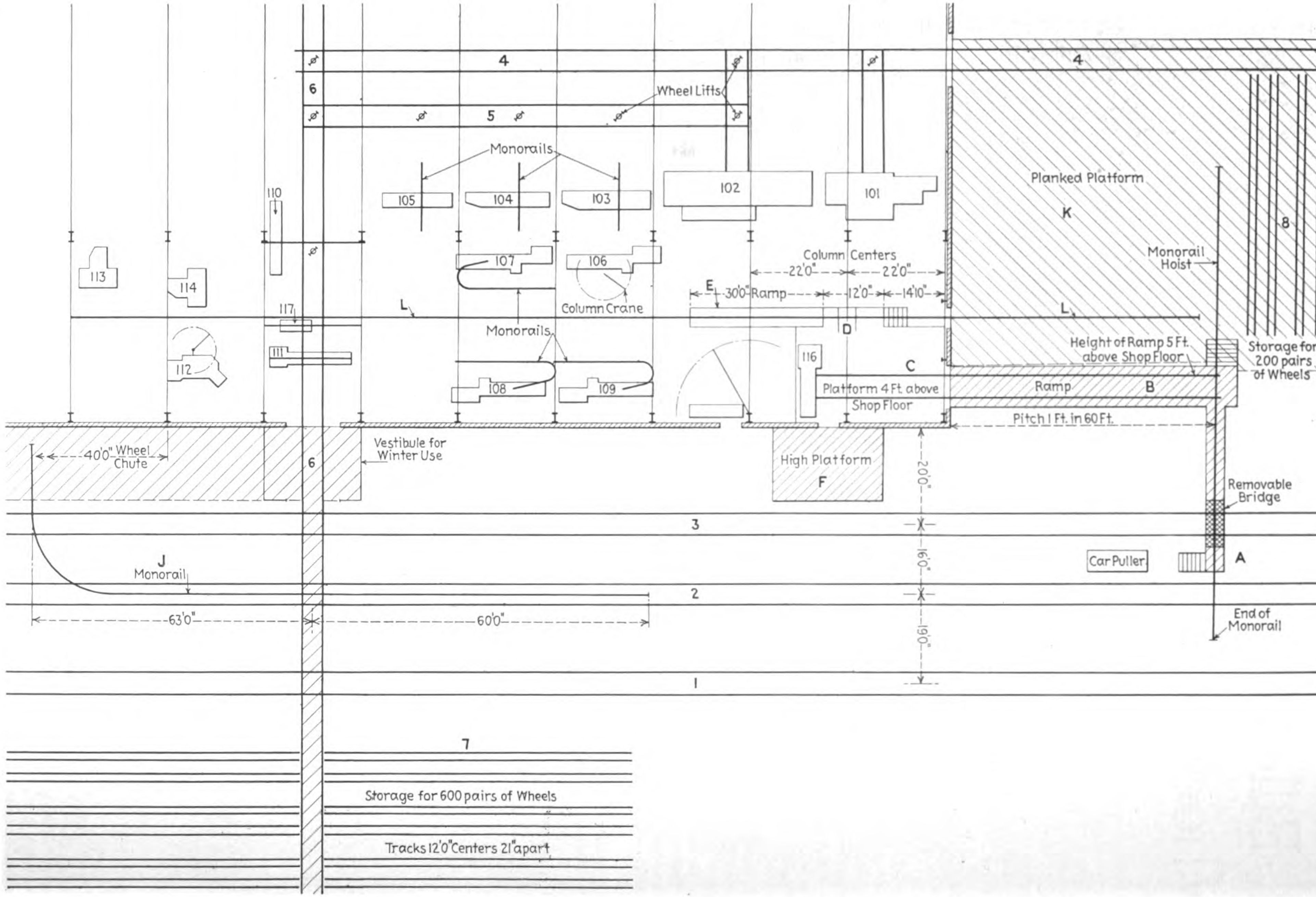






Top: The high end of the inclined ramp on which the wheels are unloaded—Center: The corner of the shop at the demounting press — Bottom: The crane over the planked storage platform

the demounting press, or they are carried on over to storage tracks 8. Wheel sets of Group 2 are carried over to storage or directly to Track 4 and to wheel lathes 101 or 102. Wheel sets of Group 3 requiring journal turning enter the shop by way of Track 4 and are handled on lathes 103, 104 and 105. Lathe 103 specializes on engine-truck wheels, while machine 104 handles car wheels. Lathe 105 handles such mounted wheel sets as can not be handled on the other two lathes. Wheel sets



Drawing showing the location of the important facilities at the North Billerica, Mass. wheel shop of the Boston & Maine

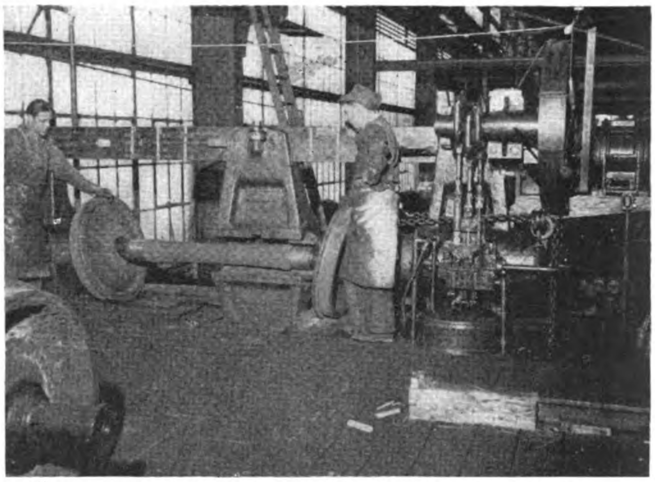
Shop Machinery at North Billerica Wheel Shop

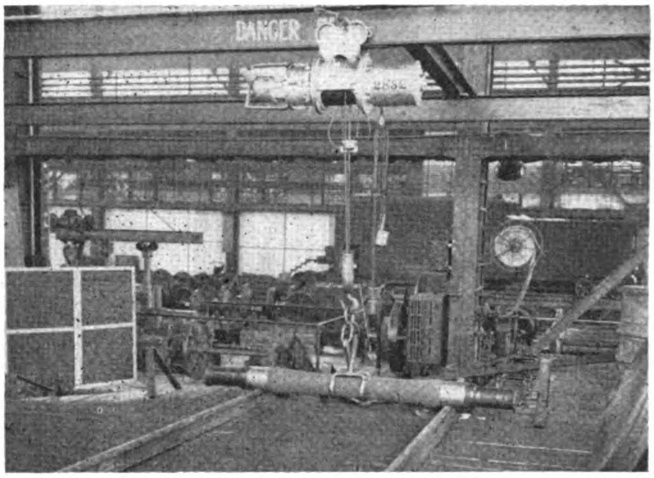
Mach. No.	Description of machine	Date acquired	Special equipment	Motor, hp., a.c.
101	44-in. Putnam car-wheel turning lathe	1914	....	......
102	50-in. Sellers car-wheel turning lathe	Sept., 1940	Face plate inserts for roller-bearing journals; Ingersoll-Rand 6,000-lb. air hoist.	50
103	Betts - Bridgeford four-carriage, gap type journal-turning lathe	1929	....	15
104	Consolidated journal-turning lathe	Dec., 1940	Stellite burnishing rolls, turret tool posts	15
105	50-in. New Haven journal-turning lathe	1914	....	Belt driven
106, 107, 108, 109	Putnam axle lathes	......	....	......
110	400-ton, R.D. Wood demounting press	1914	....	7½
111	400 - ton Chambersburg single - end mounting press	1925	....	10
112	52-in. Betts hydraulic car-wheel boring mill	Feb., 1941	Oilgear hydraulic control	15
113, 114	Putnam car-wheel boring mills	1925	Chain hoist	15
115	Whiton centering machine	1926	....	2
116	400 - ton Chambersburg single-end demounting press	1927	....	10

that come to the wheel shop from inside the locomotive shop building may reach the wheel and journal lathes by way of transverse Track 6 and thence by 4 or 5, or, after reaching the intersection of either of these tracks with Track 6, may be handled within that shop bay by overhead traveling crane.

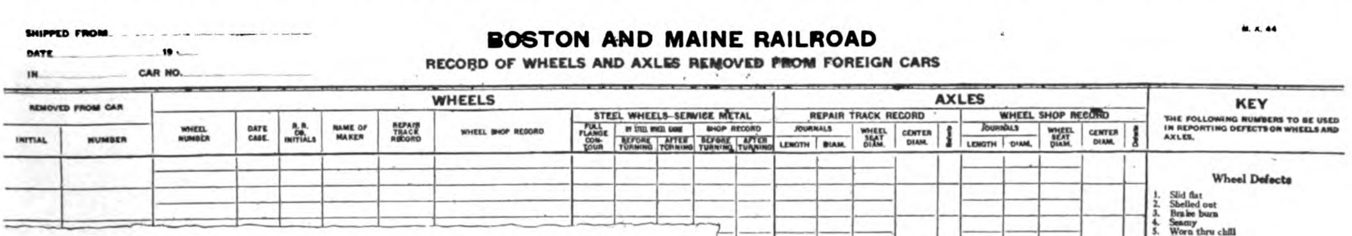
Returning again to the wheel sets that enter the shop via the inclined track on runway *B*, these may be set down by the hoist on this runway to the capacity of a full flat-car load. They move to the demounting press 116 by gravity. After the wheels have been pressed off the scrap chilled-iron wheels are rolled directly out the adjacent doorway, across platform *F*, and loaded into a car at that platform. Second-hand unmounted steel and scrap steel wheels are stored on that platform. After the axle, with two loose wheels, is rolled out of the demounting press it is rolled over to the short, inclined track *D*, and, as the wheels are removed from the axle ends, the axle drops to the track rails and rolls down to a position immediately under the monorail hoist *L*. This monorail runs from the outside storage platform *K* through the east shop wall and down the entire length of the wheel shop area to the boring-mill section. It clears the shop floor by 12 ft. and is equipped with two Shepard-Niles 1,000-lb. electric hoists. By means of this monorail the axle, if it is to be stored or scrapped, may be moved out to platform *K* or carried in the other direction to the floor storage adjacent to the four axle lathes 106, 107, 108, and 109. For the convenience of the operator of the monorail-hoist control steps lead in the direction of the outside storage platform from the demounting platform and, directly under the monorail leading in the direction of the axle-lathe section, there is a ramp, *E*, which is 30 ft. long.

Three of the axle lathes, as well as the journal lathes





Top: The demounting press is located on a platform at car-floor level; Bottom: the hoist for handling axles to the storage floor



SHIPPED FROM
DATE 19
IN CAR NO.
M. K. 44

BOSTON AND MAINE RAILROAD

RECORD OF WHEELS AND AXLES REMOVED FROM FOREIGN CARS

REMOVED FROM CAR: INITIAL | NUMBER

WHEELS: WHEEL NUMBER | DATE CAST. | R. R. CO. INITIALS | NAME OF MAKER | REPAIR TRACK RECORD | WHEEL SHOP RECORD | STEEL WHEELS—SERVICE METAL: FULL FLANGE CONTOUR | BY STEEL WHEEL GAGE: BEFORE TURNING, AFTER TURNING | SHOP RECORD: BEFORE TURNING, AFTER TURNING

AXLES: REPAIR TRACK RECORD: JOURNALS: LENGTH, DIAM. | WHEEL SEAT DIAM. | CENTER DIAM. | Defects — WHEEL SHOP RECORD: JOURNALS: LENGTH, DIAM. | WHEEL SEAT DIAM. | CENTER DIAM. | Defects

KEY

THE FOLLOWING NUMBERS TO BE USED IN REPORTING DEFECTS ON WHEELS AND AXLES.

Wheel Defects

1. Slid flat
2. Shelled out
3. Brake burn
4. Seamy
5. Worn thru chill
6. Worn flange
7. Out of Round
8. Cracked flange
9. Broken flange
10. Chipped flange
11. Tread worn hollow
12. Cracked tread
13. Thin tread
14. Broken hub
15. Cracked hub
16. Cracked plate
17. Wheel burst
18. Rim broken
19. Combination Tread Defect-Rule 73A-AAR Rules
20. High flange } By remount gauge
21. Thin flange
22. Vertical flange
23. S. H.—Wheel O. K. for mounting.
24. Shelled Out } By Remount Gauge
25. Brake Burn
26. Tread Worn Hollow

Axle Defects

1. Cut journal—can be trued
2. Cut journal—cannot be trued
3. Long journal
4. Small journal diam.
5. Seamy journal
6. Broken collar
7. Worn collar
8. Worn fillet
9. Broken axle
10. Bent axle
11. Small center—non-ara.
12. Small wheel seat
13. Wheels out of gauge.
14. S. H.—O. K. for further use

Repair track record correct

Title

Shop Inspection record correct

Title

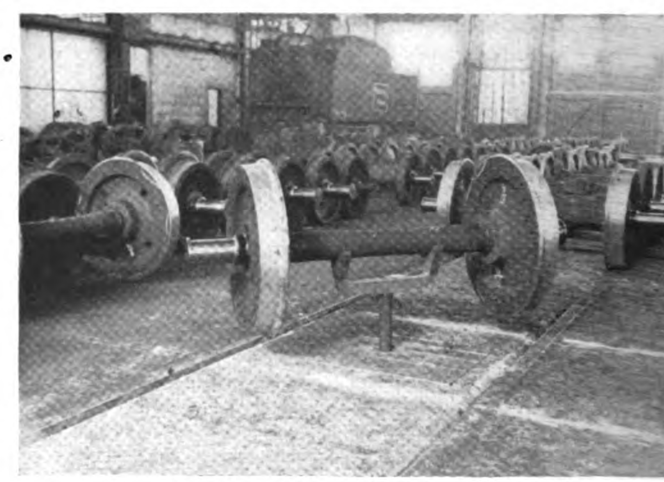
Wheels and axles shown hereon have been inspected by me, and M. C. 91 released for billing.

Title

Date

The axle-storage floor in the turning department as seen from the top of the inclined 30-ft. ramp from the demounting press

Wheel lifts are located at several track intersections



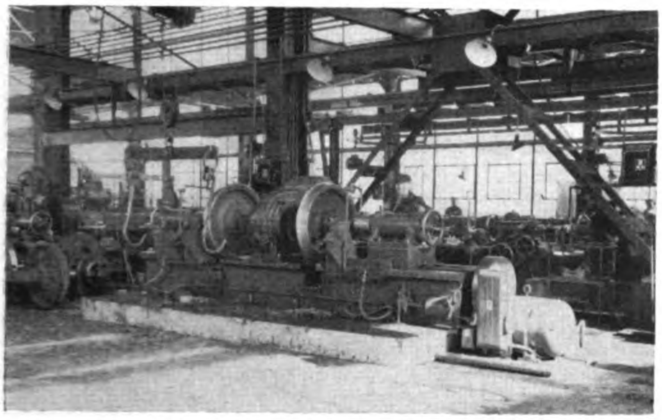
(six machines in all), are equipped with their own 2,000-lb. capacity overhead monorail hoist. In the case of the axle lathes, the location of these hoists is such that the axles may readily be picked up from the floor where they have been put down by the monorail hoist, *L*, and placed in the centers of the lathe. Centering machine 115 and axle lathe 106 are served by jib or column cranes with hoists.

At nine intersection locations on Tracks 4, 5, and 6 pneumatic wheel lifts are set into the floor. These lifts have a cradle that comes up under the axle. When the wheels have cleared the rail or floor, the cradle acts as a turntable. The lifts are operated individually by foot controls.

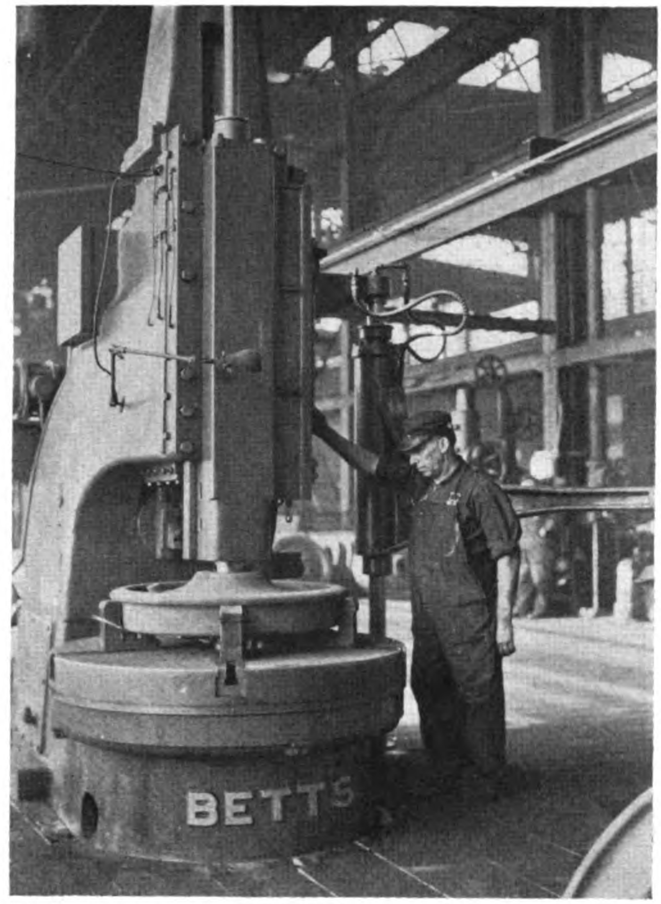
Wheels from the boring-mill section and axles from the axle section meet at mounting press 111 on Track 6. After the mounting operations have been completed, the wheel set is rolled through the press on Track 6 to the outside where it is either picked up by another monorail hoist, *J*, and loaded onto outgoing cars on Track 2, or passed on to the yard storage track 7 where there is space for 600 wheel sets. The movement from Track 6 to these storage tracks is made with wheel sticks. Mounted wheel sets from the wheel-turning or journal lathes move by way of Track 6 through the same exit.

Record of Production at North Billerica Wheel Shop

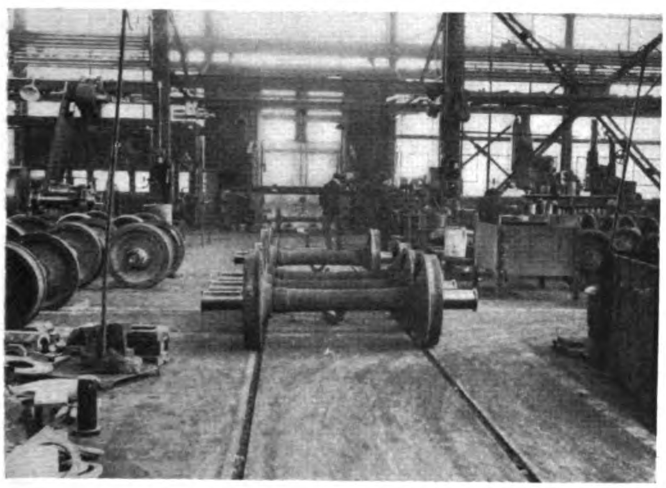
	1940				1941					
	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June
Cast-iron wheels demounted, pairs	952	941	1,181	1,017	833	907	1,287	1,397	1,097	856
Steel wheels demounted, pairs	56	98	66	64	110	58	107	67	108	61
Treads turned on mounted steel wheels, pairs	214	271	284	253	223	223	265	203	191	239
Treads ground on mounted cast-iron wheels, pairs	0	0	0	0	0	0	0	0	0	0
Treads ground on mounted steel wheels, pairs	0	0	0	0	0	0	0	0	0	0
Journals turned and burnished, mounted wheels, pairs	467	595	340	353	371	273	316	270	246	368
Cast-iron wheels bored, (No. of wheels)	...	...	...	1,492	1,604	1,668	2,224	2,289	2,202	1,572
Steel wheels bored, (No. of wheels)	...	...	...	230	188	228	348	238	240	194
New axles turned and burnished	0	0	0	0	0	0	0	0	0	0
Cast-iron wheels mounted, pairs	477	509	799	828	838	799	1,179	1,147	1,085	862
Steel wheels mounted, pairs	123	67	36	46	41	52	98	52	51	58
No. of eight-hour days worked	24	27	25	25	26	23	26	26	26	25



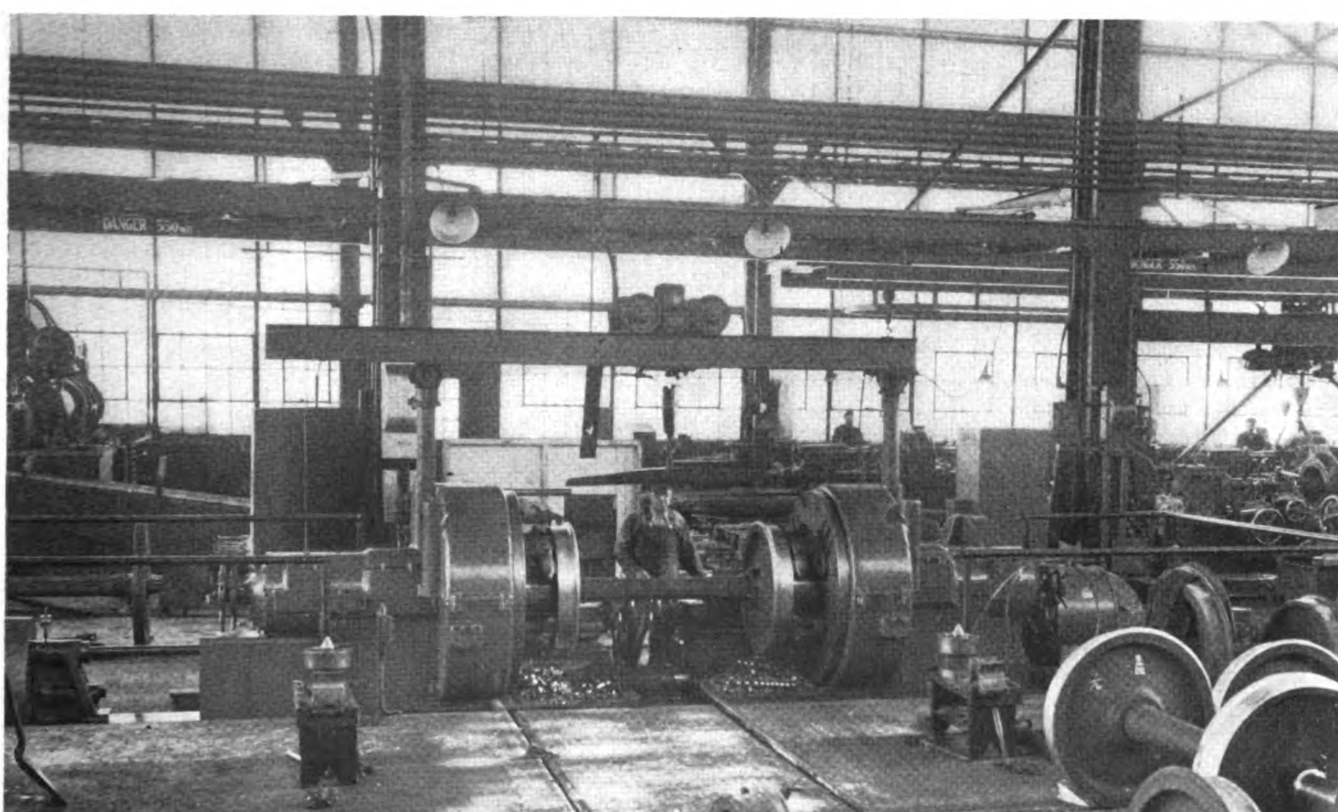
One of the modern lathes for turning journals on mounted wheels



This hydraulically controlled car-wheel boring mill is one of three machines that care for all of the wheel-boring work for the entire shop preparatory to furnishing wheels to the adjacent assembling location where the wheels and axles meet at the mounting press. At the bottom of the page is shown a new car-wheel turning lathe equipped to handle axles fitted with roller bearings without removing the bearings



The transverse shop track leading to the mounting press



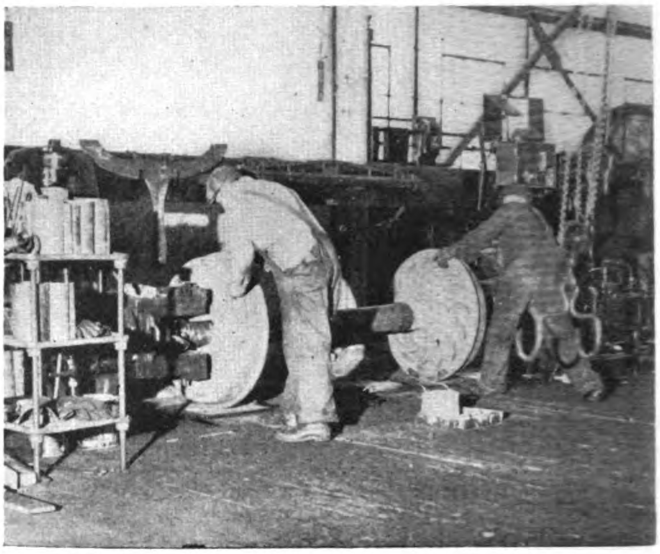
Any remounting that may be necessary is handled on the 400-ton press 110.

Thorough inspection of all incoming wheel sets is made to check the defects for which the wheels or axle were removed and sent to the shop. The record form used by the road is shown on an accompanying page. Likewise, wheels and axles are inspected at all stages of their passage through the shop and a final inspection is made before they are released for shipment to outlying points or otherwise placed in service.

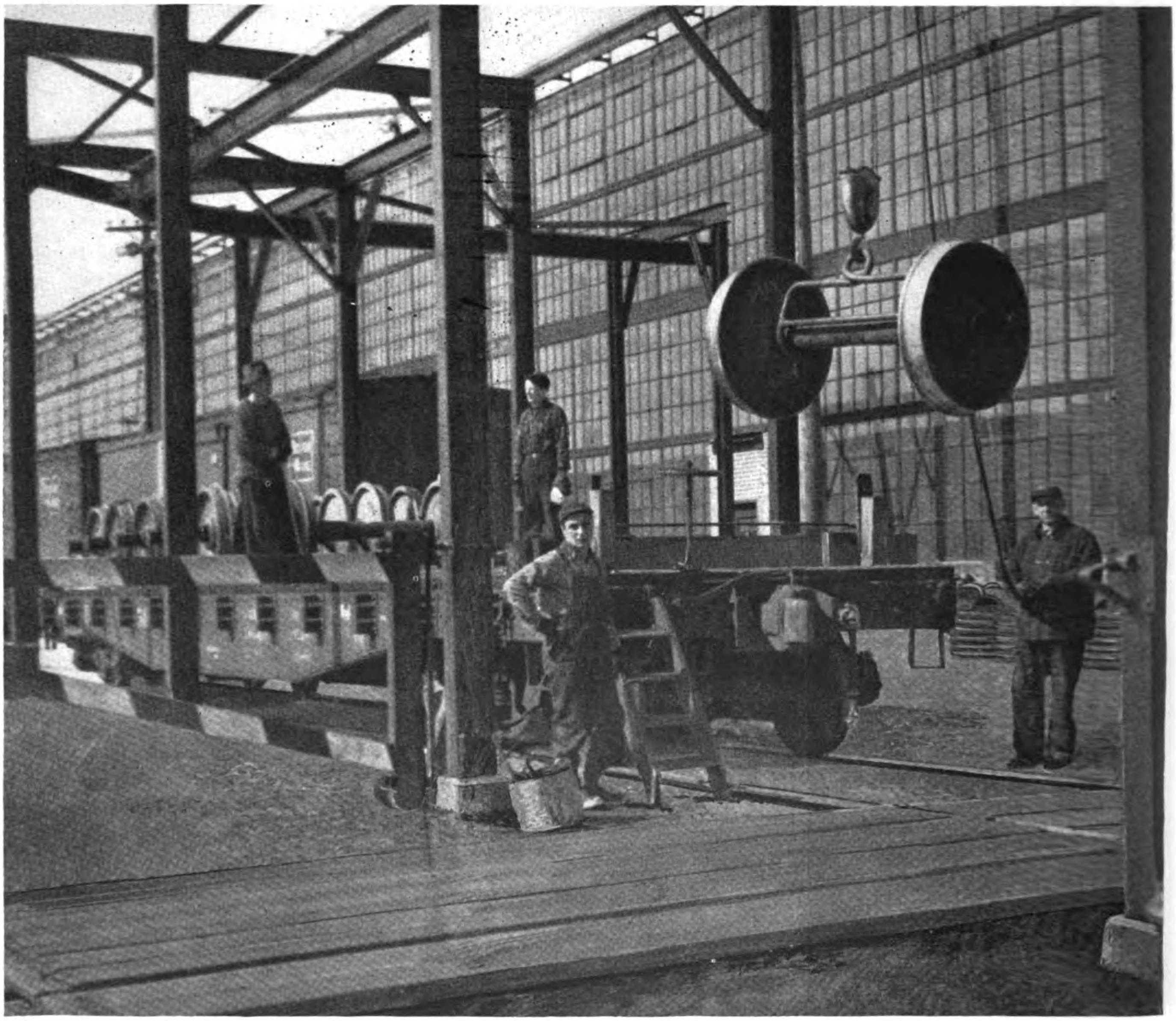
The table accompanying the shop layout drawing lists the various machines in the shop, their date of acquisition, special equipment other than that normally found on such machines, and the data relating to the motors which drive them.

Another table accompanying this article shows a tabulation of the production of the North Billerica wheel shop over a period of several months and offers means of evaluating the output of the several machines and of the shop as a whole.

This article is designed to describe the facilities and the manner in which they are used. The detail machining practices are, in general, in accordance with the recommendations of the A. A. R. Wheel and Axle Manual.



Top: A pair of wheels being handled in the mounting press—Bottom: Finished wheels are loaded by crane on cars



Decisions of Arbitration Cases

(The Arbitration Committee of the A. A. R. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Responsibility for Cars Damaged While Located on Private Track

On the afternoon of January 28, 1939, the Mobile & Ohio placed 13 empty cars on track No. 1, empty yard, at the Southwestern Illinois Corporation mine at Percy, Ill. About 7:30 p. m., January 29, 1939, these cars rolled out of that track, collided with a partly loaded car under the tipple, the 14 cars then moving into the load yard where they collided with and derailed one New York Central car and five Missouri Pacific cars, causing damage totaling $1,158.54. These six cars were placed in the joint mine yard by the Mo. Pac. The trackage on which the Mo. Pac. cars and the M. & O. cars were located, as well as that over which the M. & O. cars ran, is owned and maintained by the Southwestern Illinois Coal Corporation. The Mo. Pac. contended that the M. & O. was responsible for the damage, to which the latter disagreed. The Mo. Pac. contended that Rule 113 does not apply as the damage was not caused by an industry or non-subscriber but was due solely to negligence of the M. & O. in failing to set sufficient hand brakes or to block the cars so they would not roll off this inclined track. The M. & O. stated that the accident occurred 29½ hr. after the cars had been placed on the track. The statements of the M. & O. train crew revealed that the hand brakes on these cars were set after an emergency application of the air brakes had been made and the M. & O. stated that it is a well-known fact that when a hand brake is set while the air brakes are in emergency position, it is almost impossible to release the brakes without using brake sticks. The M. & O. did not know how or when the brakes were released on these cars but it claimed it had been shown that a sufficient number of hand brakes were set, even to the extent of one of the cars having sliding wheels. The M. & O. contended that Arbitration Case No. 1493 is somewhat parallel and, therefore, it believes the responsibility rested with the railroad placing the damaged cars on the tracks of the mining company which, in this instance, was the Mo. Pac.

In a decision rendered November 14, 1940, the Arbitration Committee stated: "The contention of the Missouri Pacific is not sustained. Rule 113 governs."—*Case No. 1780, Missouri Pacific versus Mobile & Ohio.*

Journal Packing Mixer

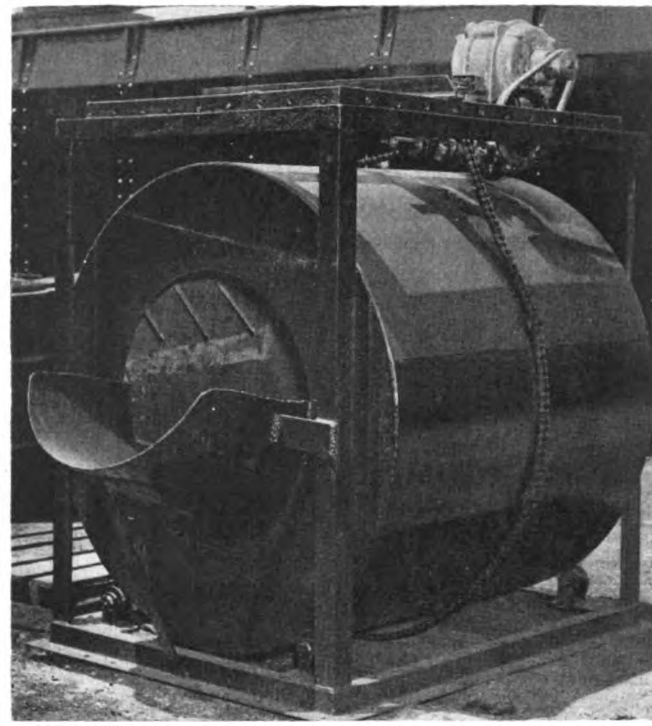


Fig. 1—Journal packing mixer used at the Illinois Central car shops, Centralia, Ill.

An efficient journal packing mixer, now being used at the Centralia, Ill., car shops of the Illinois Central, is shown in the illustrations which give a general view of the mixer in Fig. 1, and a drawing with principal dimensions in Fig. 2. This machine is used to assure that packing as applied in journal boxes has oil and waste in the same proportion as when it left the reclamation plant, where oil and waste are carefully weighed separately to know that the correct amount of both are placed in each container for delivery to the shop.

This machine is operated as follows: Two barrels of saturated waste are placed in the mixer which is turned for 5 min.; the box packers then take the packing in small lots to the car to be repacked and it is placed in the boxes a few minutes after ariving there and before any separation or settling of the oil can take place. All cars are repacked, both heavy and light repair cars passing in close proximity to this machine, from which the packing is delivered across the shop instead of lengthwise of it.

Experience indicates that the turning of packing in an ordinary barrel or container is helpful but does not assure the right mixture, and the labor cost of doing this is double that required with the mixer illustrated. This arrangement also keeps all packing at one location and simplifies delivery service. The mixer is located in a small fireproof steam-heated building and a year's use demonstrates that it has contributed materially to reductions in hot boxes.

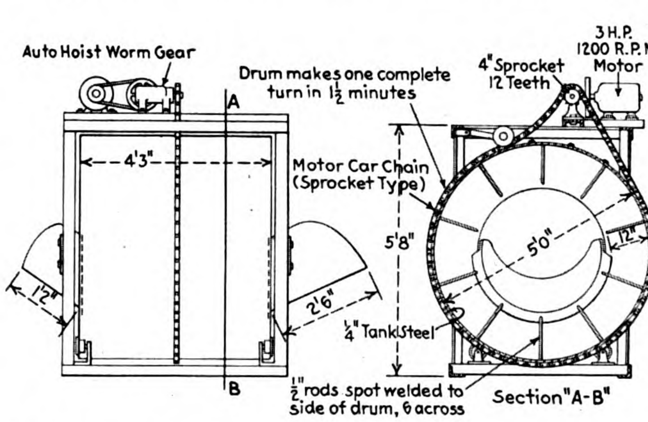


Fig. 2—General arrangement and principal dimensions of the journal packing mixer

Lightweight Car Repaired With Ordinary Shop Tools

The illustrations show both the tools and method used in repairing a welded alloy-steel box car, built by the Pullman-Standard Car Manufacturing Company, which became derailed while loaded to the roof with cedar logs and moving down a descending grade with a 10-deg. curve at a speed of 12 to 15 miles an hour. Eight other cars were involved in the derailment.

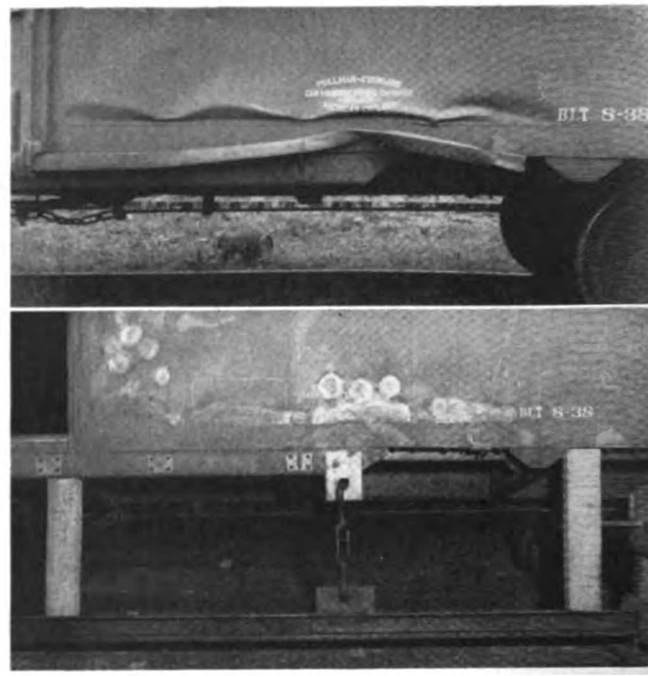
The damage to this welded car was readily repaired by the use of the simple tools illustrated, such as are available in any car shop. After repairs, the car was thoroughly water tested. It showed no leakage and was again accepted for service. No rivets were applied except where used originally in the car.

How the Defective Parts Were Removed

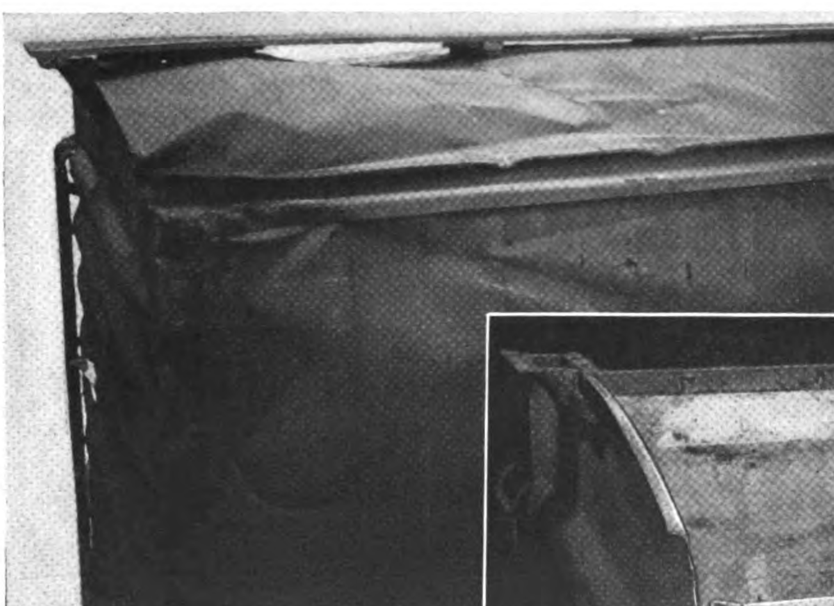
The longitudinal running boards were removed by the usual method. The latitudinal running boards were taken off by unbolting at the center support and cutting out four rivets through the side plates. The damaged steel side supports and the handhold were straightened off the car without removing the lumber.

All side lining and a portion of the end lining were removed by setting the nails through the boards into the nailing strips. The grain strips were scrapped, as removed. None of the flooring was removed, but about 2-in. diameter holes were cut in the floor at the side sill to permit removal and replacement of the side step and the door track rivets. All rivets were cut out with a pneumatic chipping hammer, or chisel. The side ladder and the door track were removed from the car and straightened hot on a face plate.

Intermediate roof sheets were removed by cutting with the pneumatic chisel along the edge of the carline and the inside face of the top end sheet and the side plate. The track-welded part of the roof remaining at the side plate was pried loose and the welded spots ground smooth. The remaining roof sheets were bulged up approximately 6 in. at the center and the carlines were similarly buckled, narrowing the car at the top.



(Above) Damaged side sill, door track and side sheets—(Below) Turnbuckle used in hot straightening the side sill and stiffener



Above: Damage at one end of the car caused by the derailment

Below: Damaged roof sheets and portion of side plate removed—Two new side sheets in position

In straightening the roof, three oak timbers 10 in. by 6 in. by 10 ft., made up from 10-in. by 2-in. by 10-ft. pieces spiked together, were sawed to fit the contour of the roof to a 21-ft. radius. These timbers were placed on the roof directly over the carline and then weighted with about a 1,500-lb. die block, as shown in one of the illustrations. Inside the car from side plate to side plate, a pipe screw jack was used, and as the carlines were straightened cold with a special "dog" wrench, the strain on the screw jack with the weight of the die block on top of the buck-up timbers brought the car to proper width and at the same time, forced the remaining roof sheets back to their proper contour position.

The new roof sheets were punched with a single row of $\frac{3}{16}$-in. holes spaced $1\frac{3}{4}$ in. at the side plate and end sheet connections and with a double row of $\frac{3}{16}$-in. holes on the same centers across the roof sheets. The new sheets were clamped down and electric welded through the small holes, with a continuous electric weld across the joint lap from side plate to side plate. The carlines were straightened as far as possible cold, with a hand hammer and buckup block and were then welded where cracked.

The carlines were straightened with this hand tool

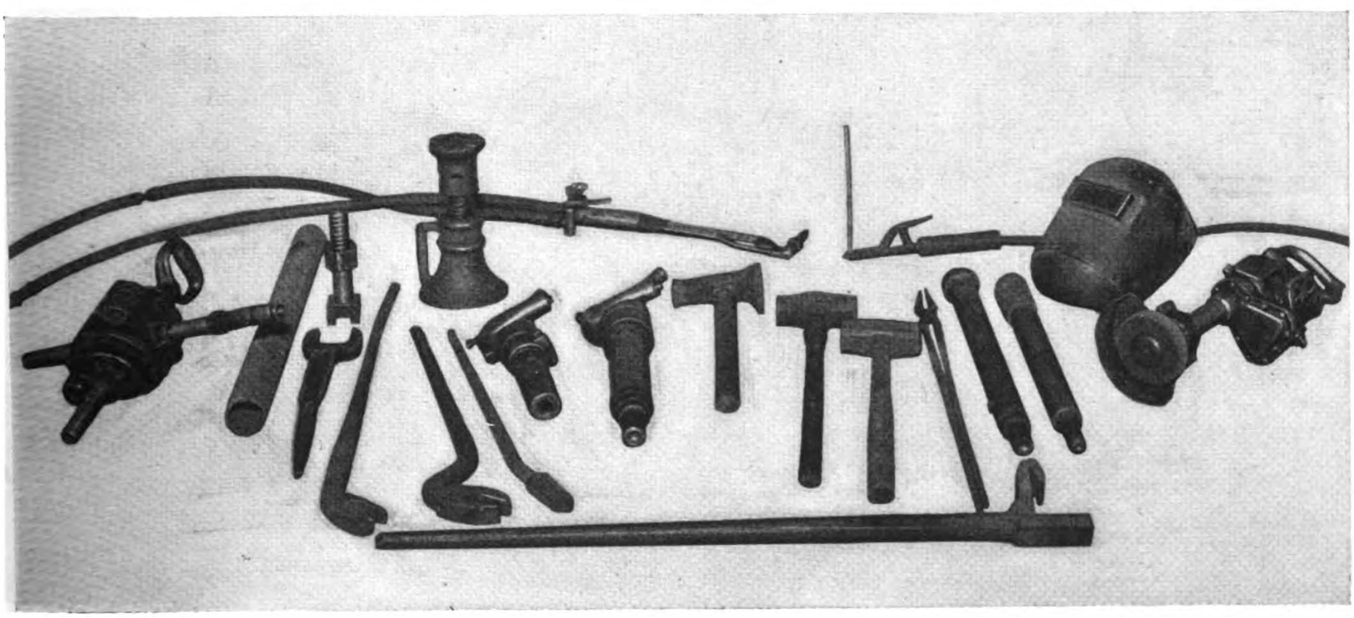
Method of Repairing the Damaged Side Sheets

The damaged side sheets, after ladder and end-sheet rivets were removed, were cut loose with the pneumatic chisel along the line of the side plate, side sill, and side post. The small section of sheet remaining was torn loose from the sill and weld spots ground flat. In cold straightening the side sheets remaining on the car, the top of the car was braced from side plate to side plate and then pulled together with a turnbuckle, using a wooden ram to strike the sheets directly over the side posts. To protect the sheets from damage, a wood buffer strip was placed along the edge of the post from side plate to side sill. The buckles in the intermediate side sheets were straightened at the side sill by drilling through at the weld spots to loosen the sheet; then heating the buckles with a torch and straightening with a hand hammer, the weld spots were ground flat and the sheets re-welded through the drilled holes. Drilling through the weld spots was found to be the only satisfactory method of loosening the side sheets without tearing them at the weld. On the new side sheets, $\frac{3}{16}$-in. holes were punched at the side plate, side sill, and joint lap. After the sheets were clamped in position, they were welded through the small holes and also the full length of the lap.

The damaged section of the side plate, at both ends of the car, was cut out with a torch, the ends squared and beveled with the pneumatic chisel and a new section of side plate was then fitted and welded on both sides. The top end sheet was reinforced by welding a $\frac{3}{16}$-in. plate at the end of the side plate. The side posts were straightened, both hot and cold, on the car, using a torch, hand hammer, steel buck-up block and "doh" wrench and were welded where fractured.

Pulling Device Used in Straightening Side Sill

The side sill was straightened hot with a special pulling device, as illustrated, made from a steel rail to which was welded a $\frac{3}{4}$-in. slotted plate. Directly above the



Ordinary shop tools used in repairing damage to welded alloy-steel freight car

slotted plate on the rail, a similar plate was welded to the side sill and a turnbuckle applied at this point, while at each end of the rail one 8-in. by 8-in. wood block was placed under the crossbearers. As the sill was heated, pressure was applied at the turnbuckle, and the sill brought back to its proper position. Due to the fact that the sill was bent both upward and toward the center of the car, a screw jack was also placed between the center sill and the flange of the side sill. As the sill was heated, this jack was used to force the sill out to position. The wood floor at this point was loosened and pushed up slightly from the side sill flange. This was done to prevent the burning of the floor when heating the sill.

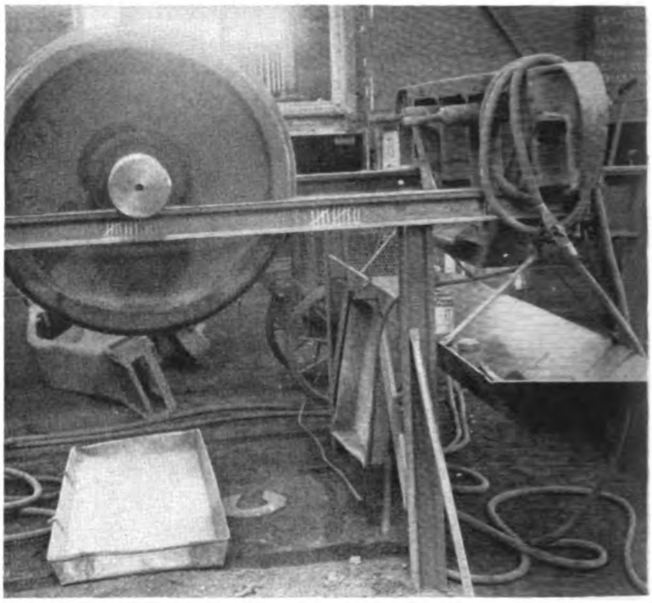
The side-sill stiffener was straightened hot on the car. The AB valve was removed for clearance and holes drilled through the stiffener. One-inch plates were then fitted inside the stiffener and bolted through the drilled holes, while C-clamps, attached to a short steel rail, were fastened to the outside of the stiffener. As heat from the torch was applied, by tightening the bolts and C-clamps, the stiffener was brought back to position. A few remaining kinks were "ironed out" with a No. 90 pneumatic hammer, using a flat die with buck-up block. Two drilled holes were welded shut.

The damaged flange of the end sheet, where riveted to the side sheet, was straightened hot by clamping a steel rail the full length and using a flatter, sledge, and torch. Torn places on the end flange were welded. The inside corner posts, which were cut out with a torch where they were welded to the end sheet, were replaced by welding.

The doors were removed from the car for straightening. A section of door sheet immediately back of the stiffener was cut out, and the stiffener then straightened through this opening with a small, narrow flatter. A patch was then welded to the door sheet on the inside where cut out. The door stiles were straightened hot on a face place and welded where broken. The door posts were straightened on the car by heating in various places and jacking from opposite side. Fifty per cent of the wood inside lining was reclaimed and reapplied.

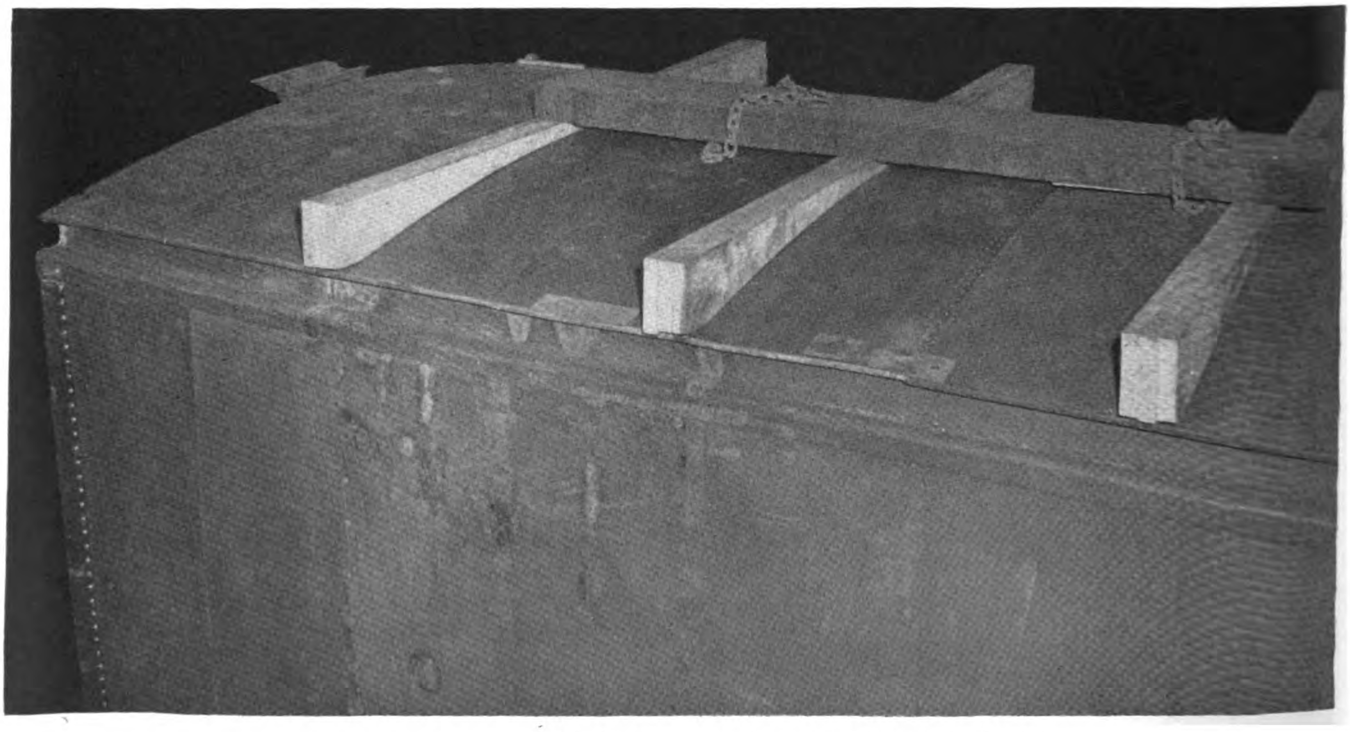
Magnafluxing Car Axles And Truck Side Frames

The special equipment used in Magnafluxing all freight-car axles, truck sides, bolsters, etc., at the Burnham shops of the D. & R. G. W. is illustrated. Car axles are rolled along the elevated rails, and tested in the usual



Special equipment for Magnafluxing car axles and truck sides at the Burnham shops of the D. & R. G. W.

manner, a pan being used to catch the Magnaflux powder for re-use. Truck sides and bolsters are first annealed with careful attention to the initial temperature and rate of cooling. Wire brushing then cleans the surfaces for thorough inspection, and the truck sides and bolsters are moved to the elevated rails. To catch the powder, a large



Formed oak timbers and 1500-lb. die block used in straightening the car roof

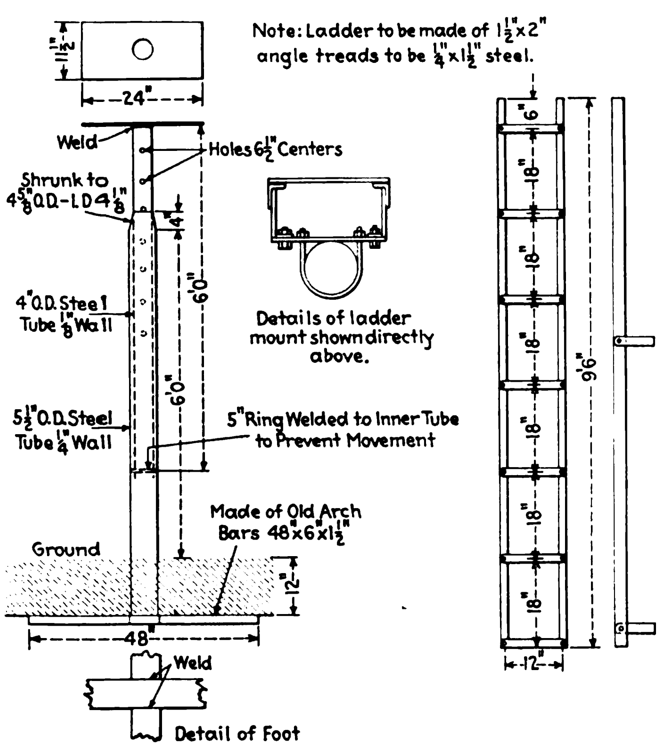
sheet metal tray is suspended under the truck side. The Magnaflux operation shows up any concealed surface cracks or potential defects. The sheet metal tray is 14 in. wide by 9 in. deep by 7 ft. long. The other tray under the wheels is 18 in. wide by 4 in. deep by 52 in. long.

An examination of the record of car axles, truck side frames and bolsters tested by the Magnaflux method at Burnham shops for a single week shows 47 axles inspected, of which only one was condemned. Out of 24 side frames inspected, 17 were found O. K., and seven condemned. Out of 12 bolsters inspected, three were found O. K., nine condemned. As of July 5, 1941, the record at Burnham shops for 319 cars shows 1,276 side frames inspected, 1,028 found O. K., and 248 condemned. During this period, 638 bolsters were inspected, of which 356 were O. K., and 282 condemned. Of 1,275 axles inspected, 1,270 were found O. K., and five condemned.

Steel Freight Shop Scaffold

The scaffolding illustrated was made with scrap locomotive boiler flues used for the posts. The main posts measure 5½ in. in diameter and 6 ft. 4 in. in length, and have the reduced bottle end up. Within this bottle end, which has an inside diameter of 4⅛ in., slides the inside post which is 4 in. in diameter and 6 ft. long.

To take up the play between the bottom end of the inner post and the outer post, a 2-in. collar is welded to the bottom of the inner post. A plate of second-hand tank steel, ⅜ in. by 11 in. by 24 in., is welded to the top end of the inside tube and is punched for easy fastening of the scaffolding.



Support for scaffolds used in repairing freight cars at the Burnham steel shop of the D. & R. G. W.

A scrap arch bar, 1⅜ in. by 6 in., cut to a length of 48 in., is used for the base. This bar, together with two 20-in. pieces, are welded to form a cross. The post is welded in place at the intersection.

To adjust the height of the scaffolding, an 1$\frac{1}{16}$-in. hole is drilled through the outside tubing 1¼ in. from the top. A ⅝-in. key bolt is inserted into the hole, and also through any one of the nine holes of the same size drilled through the inner post and spaced at 6-in. intervals. The scaffold can thus be raised or lowered by sliding the inside tube up or down within the outer tube. The full height will reach 11 ft. 6 in.

A jig was made for welding the top and bottoms to the tubes. One welder was able to weld seven posts in eight hours. This jig, together with the scrap material, kept the cost of the scaffold posts relatively low.

Air Brake Questions and Answers

AB-8, Empty and Load Equipment (Continued)

14—*Q.—How does the ABEL-1 valve compare with the AB valve?* A.—It has the same operating parts as the AB valve. It has a special pipe bracket with an additional pipe connection, the purpose of which is to supply brake-pipe air to the change-over valve.

15—*Q.—Are the pipe connections to the ABEL-1 valve the same as the standard AB equipment?* A.—All except the brake-cylinder pipe, which is connected to the change-over valve.

16—*Q.—What is the function of the change-over valve?* A.—To direct the flow of air from the ABEL-1 valve to the brake cylinders in accordance with the empty or load setting.

17—*Q.—What portions comprise the change-over valve?* A.—As shown in Figs. 5 and 6, it has four portions: pipe bracket (*85*); cut-off valve portion (*65*); change-over portion (*2*) and transfer valve portion (*40*).

18—*Q.—What is the purpose of the pipe bracket?* A.—It provides for all pipe connections and contains two chambers.

19—*Q.—What are there two chambers?* A.—Brake-cylinder volume and strut-cylinder volume.

20—*Q.—What is the purpose of the brake-cylinder volume?* A.—To provide a constant pressure-volume ratio between the brake-cylinder pressure development and the brake-pipe reduction when in empty position, which is a basic feature of the standard single-capacity AB brake.

21—*Q.—How is this accomplished?* A.—By connecting the brake-cylinder volume to the empty brake cylinder in empty position, the combined volume of the chamber and the 8-in. cylinder is equivalent to that of a 10-in. brake cylinder. As the standard auxiliary reservoir volume is used, the pressure-volume relationship between the auxiliary reservoir and the brake cylinder is that of the standard AB single-capacity brake. In load position the volume is cut out for the reason that with the load cylinder cut in the combined volume of the empty and load cylinders equals that of the 10-in. brake cylinder.

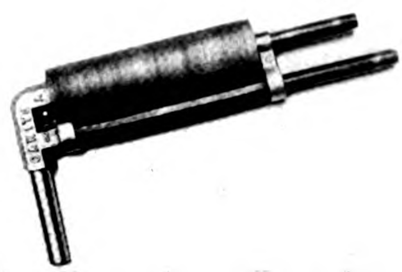
22—*Q.—How is the entry of insects through exhaust ports prevented?* A.—By the use of wasp-excluder fittings in the exhaust openings in the bracket and in the cut-off portion.

NEW SHOP TOOLS AND EQUIPMENT

Cleaning Car Heating And Cooling Coils

An air gun designed specifically for cleaning heating and cooling coils of air-conditioned club cars, diners, coaches and other passenger units and which is said to speed-up and simplify this maintenance work has recently been developed by Oakite Products, Inc., New York. Known as the Oakite Solution-Lifting Air Gun, Model No. 391, this device makes it practical to clean heating and cooling coils of many types of air-conditioning equipment in place, thereby eliminating the necessity of taking out units from cars and cleaning them manually.

For operation the gun uses compressed



Oakite solution-lifting air gun

air of from 40 to 90 lb. pressure, and requires hose for both air and cleaning solution. The solution is made up with a special, water-soluble material, Oakite Penetrant. For air pressure up to 50 lb., an air hose of ¾ in. inside diameter is recommended to assure the most effective results. For pressures of 50 lb. or more, an air hose of ½ in. inside diameter is recommended.

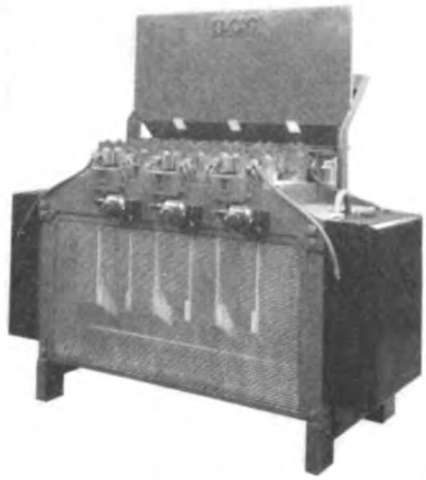
The gun is one foot in length and weighs 2 lb.

Electric Heaters for Forging Machines

The illustrations show two electric metal heaters, for use preparatory to bolt heading or otherwise upsetting the ends of bars in forging machines, which are built by the American Car and Foundry Company, New York.

The No. 5 heater is a type of which eight are in service in a General Motors plant for making drag links. The bar to be heated is gripped by the electrodes, the portion of the bar between the electrodes being heated prior to upsetting and piercing. In producing grab-handles and ladder rounds in the car shop about 5½ to 6 in. at the ends of the bars would be heated.

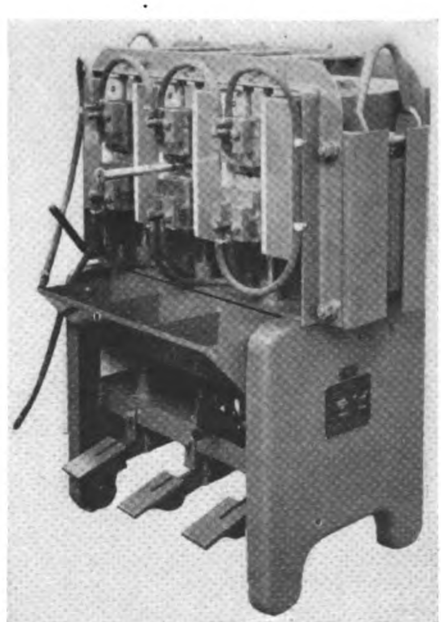
The No. 5 heater is a three-electrode machine. With all electrodes working, it



The Berwick No. 5-3 Type G forging heater

is capable of producing 300 heats per hour, the equivalent of 150 completed grab handles or ladder rounds.

The other illustration shows a Berwick No. 3 three-electrode rivet heater equipped with special blocks for heating 1½ to 2



A Berwick three-electrode rivet heater equipped with special die blocks for use in bolt heading

in. on the ends of bolt stock preparatory to heading in a forging machine. The blocks are water cooled and the machine is capable of a production of 200 to 300 heats an hour, depending upon the diameters. Any diameter from ⅜ in. or smaller up to 1 in. can be heated in this machine.

Machine-Tool Motors Of Small Capacity

A fractional-horsepower motor, built specifically to meet the requirements of machine tools and other industrial applications where frequent start-stop service, plugging, and metal-dust atmospheres are encountered, has been introduced by the General Electric Company, Schenectady, N. Y. It is available in ¼-, ⅓-, ½-, and ¾-hp. sizes for operation on three-phase and d-c systems.

The new motor is of totally enclosed construction and has several design fea-

A fractional-horsepower motor for three-phase or direct-current systems

tures to provide it with the high degree of rigidity and sturdiness demanded in machine-tool operation. Its outstanding features include a sturdy base, closely machined end-shield and stator rabbets, tough wire, ball bearings, a one-piece indestructible cast-aluminum rotor, and firmly anchored windings. A convenient conduit box built into the totally enclosed endshield contributes to the motor's compactness and pleasing appearance.

The stator is especially designed to withstand the stresses of starts and stops as well as plugging and momentary overloads. Formex, G-E's new heat- and sol-

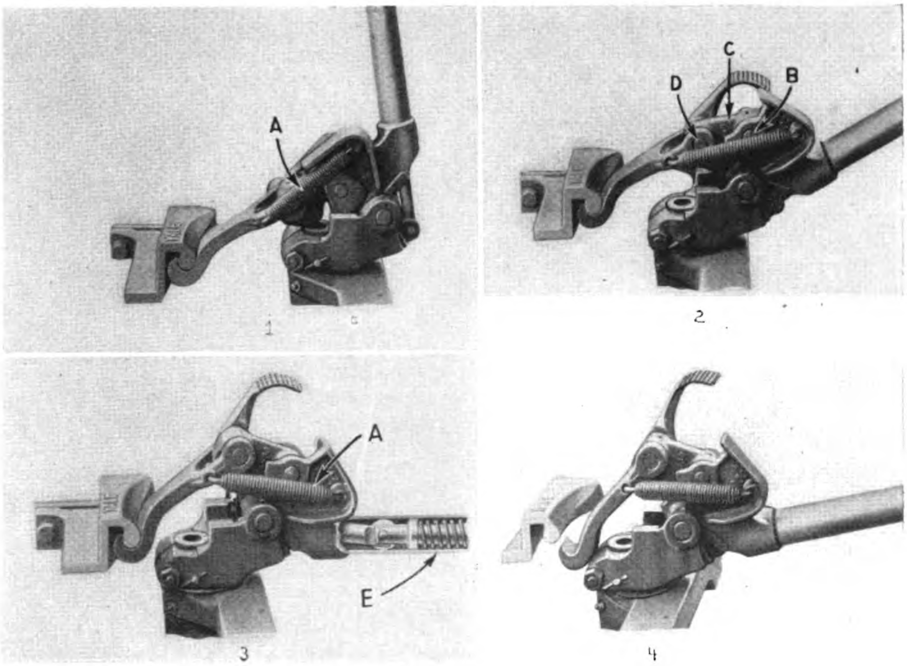
vent-resistant magnet wire, is used for the windings which are wedged in the stator slots and firmly anchored. Both stator and end-shield rabbets are machined to close tolerances, providing concentricity between the rotor and the stator, so that a uniform air gap is maintained.

Ball-bearing assemblies are used in the new motors. This allows the mounting of the motors with the shaft at any angle to the horizontal. End-mounted motors can be placed vertically as well as horizontally and may be obtained for flange, flat-face, or rabbet-machine mounting.

Base-mounted motors are furnished with a sturdy, malleable, cast-iron base, solidly bolted to the stator. The mounting dimensions of this base are similar to those for motors of comparable frame size which have been furnished previously for machine-tool service.

Hand Trucks with Single-Stroke Lift

In its present lines of Red Streak and Blue Streak hand lift trucks the Yale & Towne Manufacturing Co., Philadelphia, Pa., has included a simplified, single-stroke lift feature. There are fewer moving parts and safety features are incorporated in the lift mechanism to prevent tripping and "flying handle." How this compound lift mechanism changes the lifting ratio, flattens the lift curve, and requires less lifting effort is shown in the illustrations.



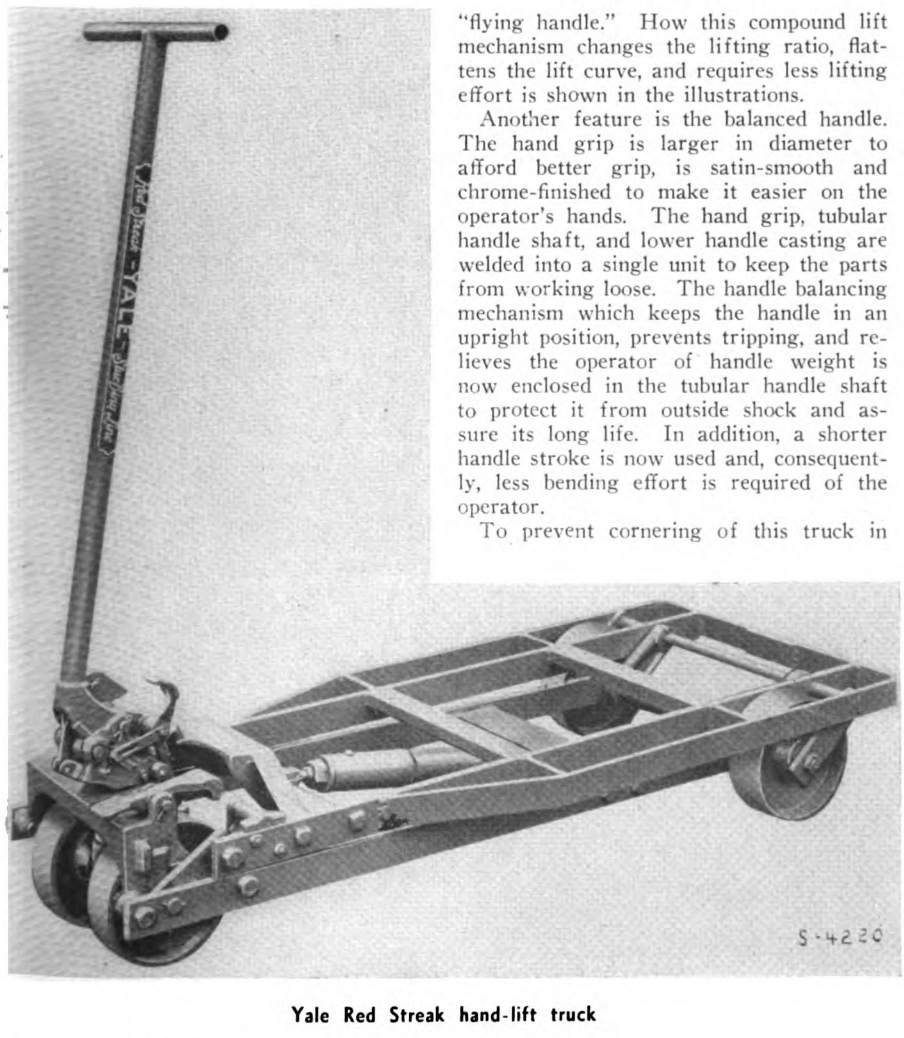
(1) Ready to lift—The heavy-duty steel lift hook is positively engaged and held securely by spring *A*—It cannot be accidentally disengaged—(2) As the handle descends a change of leverage takes place—The lifting force is shifted from *B* to *D* by the action of the intermediate link *C*—(3) The lift is accomplished and the load is positively locked in place—Secondary safety spring *E* (in handle) is forcing handle up to disengagement position where handle will be free of the load—(4) Secondary spring has raised handle, the handle and the hook automatically drop out of engagement

Another feature is the balanced handle. The hand grip is larger in diameter to afford better grip, is satin-smooth and chrome-finished to make it easier on the operator's hands. The hand grip, tubular handle shaft, and lower handle casting are welded into a single unit to keep the parts from working loose. The handle balancing mechanism which keeps the handle in an upright position, prevents tripping, and relieves the operator of handle weight is now enclosed in the tubular handle shaft to protect it from outside shock and assure its long life. In addition, a shorter handle stroke is now used and, consequently, less bending effort is required of the operator.

To prevent cornering of this truck in cramped quarters, loads may be elevated with the handle at any point within a 90-deg. arc. Steering may be accomplished through a full 180 deg. For easier rolling, all wheels are steel with a machine-smooth face. Wheels are mounted on ball bearings which are sealed against dirt intrusion by built-in hardened-steel washers.

The front head and steering column are solid steel castings assembled on a fifth wheel with a hardened and ground thrust washer to assure long life and low maintenance.

Both trucks are available in either wide or narrow frame models. The Blue Streak models have a capacity of 2,500 lb. and the Red Streak models, 3,500 lb.



Yale Red Streak hand-lift truck

Special-Purpose Welding Electrodes

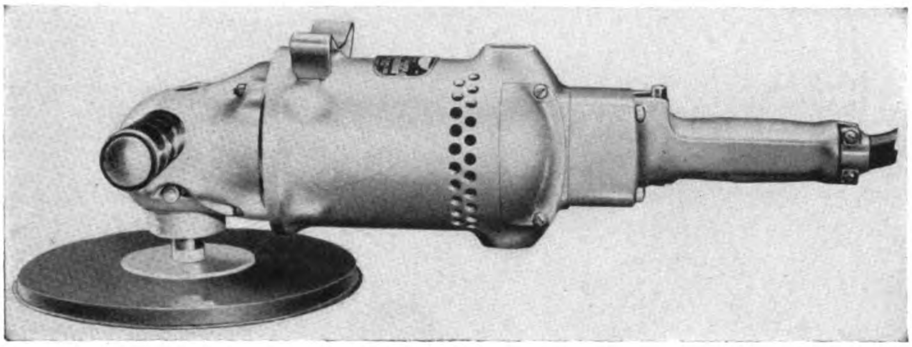
Two electrodes of special composition are among the recent developments of the Lincoln Electric Co., Cleveland, Ohio. One is a special electrode for reclaiming worn parts. Known as Hardweld 50, it is lightly coated and of reversed polarity for building up dense, tough, medium-carbon deposits which resist deformation and wear and which are machineable at slow speed. On straight carbon steel, if allowed to cool naturally, the deposit has a hardness of 20 to 35 Rockwell C. Hardness may be increased by water-quenching from approximately 1,500 deg. F. Hardweld 50 is made in 3/16-in. and 1/4-in. rods 14 in. long.

The other new electrode is Stainweld D, made particularly for work in 25-20 stain-

less steels and for surfacing worn parts to resist corrosion and impact. It is useful for welding steels which are air hardening and which cannot be heat treated after welding. The electrode produces an exceptionally smooth bead with corrosion resistance equal to or greater than that of the parent metal. Tensile strength is 80,000 lb. to 90,000 lb. per sq. in. with ductility of 35 per cent to 45 per cent elongation in 2 in. The electrode is made in 3/32-in., 1/8-in., 5/32-in., 3/16-in. and 1/4-in. sizes, 11 1/2 in. long.

Heavy Duty Production Sanders

Heavy duty production sanders for use with 9-in. abrasive discs have been developed by The Black & Decker Mfg. Co., Towson, Md. The standard motor which



The Black & Decker 9-in. heavy sander

operates on 110 volts runs at a no load spindle speed of 5,000 r. p. m. It is equipped with a spindle lock which facilitates quick changing of the disc. It is fully equipped with ball bearings and the bearings are grease sealed against dust and dirt. The switch and commutator are also sealed. The disc is driven through spiral bevel gears. The motor is ventilated with a pusher type steel fan which forces straight-line ventilation through ample vent slots.

This machine is suitable for continuous high-speed production metal finishing; grinding metal, stone, or tile surfaces with saucer wheels; removing scale, rust and paint with a wire brush, and shaping wood surfaces with planer heads. Smaller and lighter machines of similar design are also available where production and maintenance work calls for intermittent use of the sander rather than continuous high-duty performance.

Cincinnati Hydraulic Universal Grinder

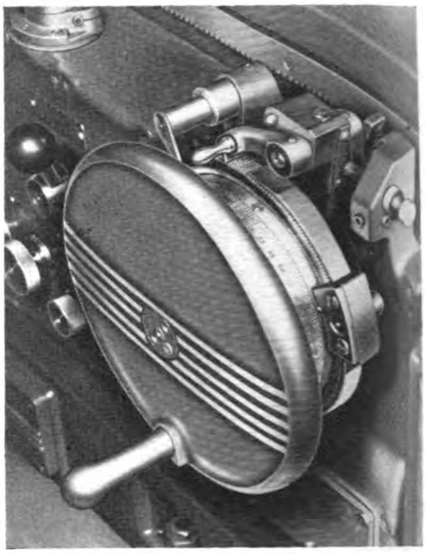
A line of universal grinding machines, built in 14-in., 16-in. and 18-in. swings, and 36-in., 48-in. and 72-in. between-center lengths for each swing, have recently been announced by Cincinnati Grinders Incorporated, Cincinnati, Ohio.

The table is powered hydraulically, having infinitely variable traverse rates of 3 in. to 220 in. per minute. The power table stroke may be set as short as 3/32 in., simulating the action obtained from a reciprocating grinding-wheel spindle. Accuracy of automatic reversal is within .004-in., allowing the operator to power grind exceptionally close to shoulders without fear of spoiling the work. The hand table traverse has two speeds (mechanically controlled)—1/10 in. per turn of the handwheel for close adjustment and grinding shoulders; 15/16 in. per turn for setting up. Hand servo power control may be obtained as an extra. This feature is useful when the operator must frequently traverse the table by hand.

Filmatic bearings are used for the main grinding-wheel spindle. Each bearing consists of five heavy steel segments or shoes with bronze lining next to the spindle. These shoes are constructed to create wedge shaped oil films, and are self-adjusting for variations in load produced by the variety of grinding cuts encountered with universal machines. A plain bronze thrust bearing, self-adjusting for wear, is located midway between the ends of the spindle. Oil under a definite pressure completely fills the bearing compartment. The spindle can not rotate until this pressure is attained, and conversely, the spindle drive motor automatically stops if the oil supply should fail or diminish.

The wheel head may be swiveled 90 deg. right and left. Mounted directly on top of the wheel head unit, a 5-hp. motor drives the grinding wheel spindle through V-belts.

A hinge-type bracket at the front of the wheel head contains the internal grinding

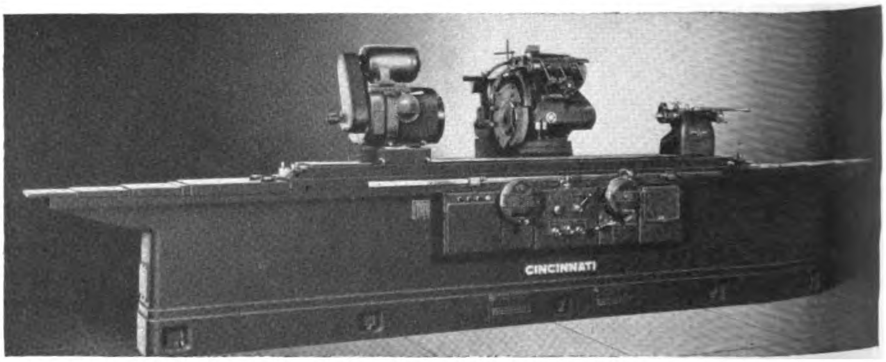


Graduations on the cross-feed handwheel facilitate hand adjustments

quill and spindle. The attachment is always in place, yet completely out of the way for any job within the capacity of the machine. It may be quickly set up by swinging it down and tightening only one bolt.

The headstock incorporates a new type of drive known as the Speed Ranger. By merely turning a handwheel at the front of the unit, an infinite number of speeds may be selected, ranging from 25 to 225 r.p.m. If desired, an optional range of 40 to 360 r.p.m. may be obtained. Graduations on the base of the unit are for a swivel range of 90 deg. forward and 30 deg. to the rear. Like the hand table traverse, hand cross traverse has a two-speed arrangement; .050 in. per turn of the handwheel in low gear and .25 in. per turn in high gear. The graduations on the rim behind the handwheel constitute a convenient innovation in grinding machine controls, especially for repetitive multiple diameter work. Diameter reduction as small as .0001 in. may be obtained by hand adjustment. Automatic pick feed may be set for one to seven notches on the cross-feed handwheel, reducing the work diameter .0004 in. to .014 in.

Lubrication is principally automatic. Table ways are protected with telescopic guards, and are pressure lubricated with filtered oil from an individual reservoir. The grinding wheel spindle bearings are



Cincinnati 16-in. by 72-in. hydraulic universal grinder—These machines are also made in 36-in. and 48-in. between-center lengths

also lubricated with filtered oil from an individual reservoir. The same can be said of the hydraulic system, while the headstock unit has automatic splash lubrication.

All controls, including the electrical push buttons, are closely grouped, for operating convenience. To further reduce fatigue, the work rotation and coolant flow automatically start and stop with the table traverse start-stop lever. Independent controls are also provided for incidental work which does not require coolant.

Net weights vary from 7,600 lb. for the 14-in. by 36-in. machine to 10,000 lb. for the 18-in. by 72-in. machine. Motors and controls are included in these weights.

Multiple-Stop Lathe Attachments

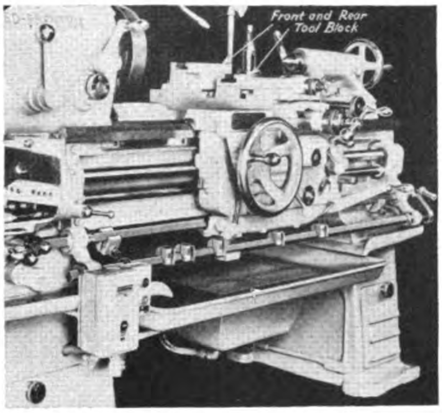
Multiple-stop lathe attachments applicable both to the longitudinal and cross feeds of the cutting tool have been developed by the Reed-Prentice Corporation, Worcester, Mass. These attachments are designed for installation on engine lathes, thereby adapting the lathe to a considerable range of production work on a semi-automatic basis. The new multiple stops

Adjustable multiple cross stops applied to a Reed-Prentice engine lathe

are available for Reed-Prentice 14-in., 16-in., and 20-in. engine lathes.

One of the illustrations shows the application of automatic multiple length stops which permit accurately duplicating shoulder lengths on repetition work. The sliding bar mounted at the front of the lathe carries a number of adjustable stop dogs. A stop handle carried on the apron engages the dogs in turn, moving the bar and disengaging the feed. A touch on the stop handle releases the dog, the rod slides back into position, and the feed is automatically re-engaged. The stop handle moves forward ready to contact the succeeding stop dog for the next shoulder length.

The adjustable multiple cross stops shown in the other illustration permit accurately duplicating diameters on repetition work. This device consists of a rod mounted in brackets across the carriage wings carrying a stop block in which are six adjustable stops. The stop block slides on the cross rod on which it is securely clamped. The stops are adjustable for the series of diameters required and may be rotated, by means of a knurled knob at the



Application of automatic multiple length stops on an engine lathe

front, into position for contacting the hardened stop dog attached to the compound-rest cross slide. After rotation, the rod is retained in position by a spring plunger.

It will be noted that the carriage is fitted with both front and rear tool blocks. These permit a variety of tooling for speeding up production operations.

Flat Surface Grinder

A complete revision in the design of its flat surface grinding machine has been made by the Diamond Machine Company of Philadelphia, Philadelphia, Pa. The bed has been lengthened, the platen is wider, the table is hydraulically driven, and throughout the machine provisions have been made for the protection of all bearing surfaces against grit and spray.

The bed is 229 in. long by 48½ in. wide and at the extreme limits of travel the platen never overhangs. The distance between the ways has been more than doubled, providing a wider foundation for the table, which rides on precision-machined ways, one flat and the other a 90-deg. V. The latter is inclined off the vertical to take up side thrust and equalize pressure on both ways. The width of the platen has been increased to 36 in. This facilitates the grinding of wider parts and allows more room for mounting the magnetic chuck.

Another of the outstanding features of this machine is the patented Fluid-Tension table drive. This consists essentially of two hydraulic pistons, the rods of which are always in tension, and is designed to provide uniform table speeds in both directions of travel. The pistons are actuated by fluid pressure from a variable-stroke reversible Hele-Shaw pump. The maximum table speed is 100 ft. per min. The table travel can be controlled manually by a hand lever or automatically by the setting of the table dogs.

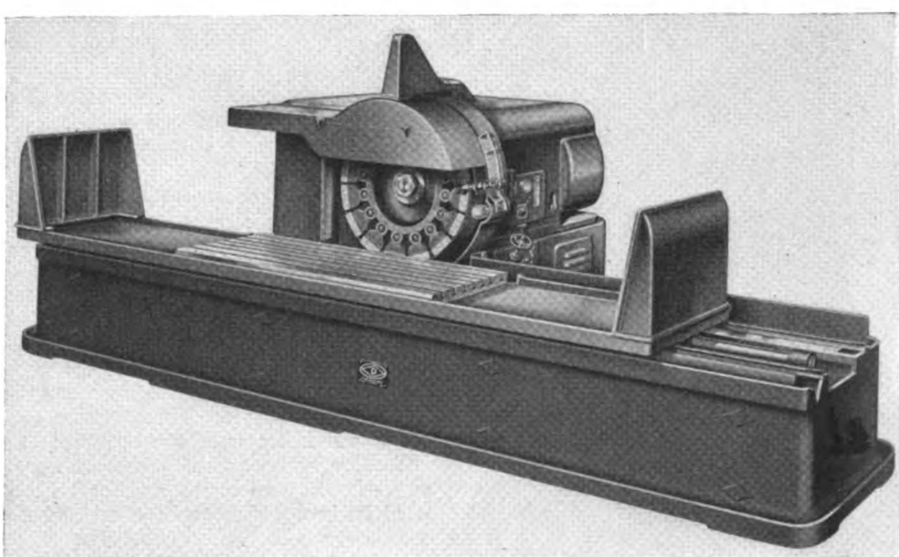
The main spindle is driven by an electric motor through V-belts. The V-belt pulley is located at the end of the spindle for ease of checking and installing belts. The spindle housing, motor, and V-belt drive are protected by rigid metal covers.

The spindles run in Timken roller bearings in a circulating lubricating oil system. The 36-in. wheel operates at 440 r. p. m.; the 30-in. wheel at 530 r. p. m.

The wheel head is designed so that it may be rotated horizontally as much as 15 deg. to permit concave grinding. This machine is normally furnished with a hand operated cross feed of the wheel. Automatic feed can be furnished if desired, however.

A star wheel dresser is attached permanently to the upper wheel guard. It may be operated by a remotely controlled hydraulic wheel-truing device while the machine is in operation.

An automatic force-feed oil system lubricates the table ways. A valve enables the operator to force oil on the table ways be-



Diamond face grinder with long bed and wide platen

fore the machine is started. A centralized system, manually operated, provides oil for the feed-screw nut, wheel-head ways, and reversing-dog gear-train bearings. The Timken tapered roller bearings of the main spindle are lubricated by a circulating system.

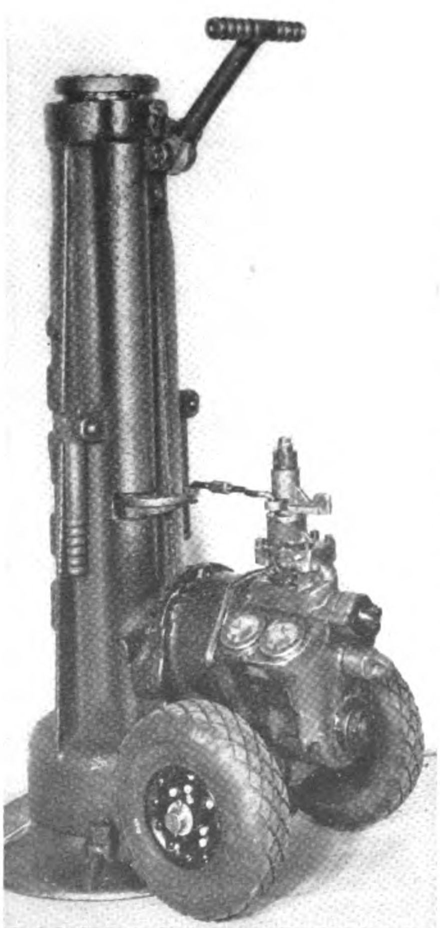
Another feature to which particular attention was devoted in the design of this machine is the location of the controls. These are all brought together near the angle between the bed and the wheel head. Here are located the table and wheelhead controls, the start and stop push buttons for both spindle and table motors, the coolant valve, control of the wheel-truing device, and the filling points for the hydraulic system and the spindle-lubricating system.

The 30-in. machine accepts work 17½ in. in height by 84 in. long with the front guard in place. With the guard removed it will take work up to 23½ in. high. The 36-in. machine, with the guard in place, will take work up to 23½ in. high by 84 in. long, and the height can be increased to 29½ in. by removing the guard.

Portable Locomotive Air-Operated Jack

In keeping with the requirements for efficiently servicing the new and heavy Diesel-powered locomotives, The Joyce-Cridland Co., Dayton, Ohio, has built a model of the Joyce air-operated jack. This jack is available in 75- and 100-ton capacities, with an overall height of 44 in. and a lift of 30 in.

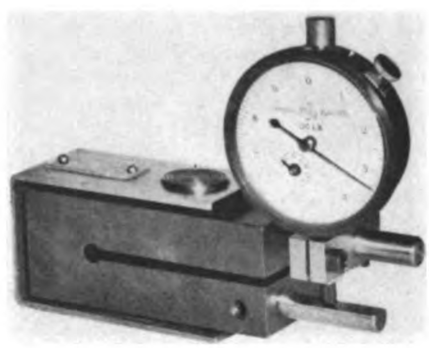
All models of the 50-, 75- and 100-ton capacity jacks may be equipped with either piston or rotary air motors. The locomotive jack is mounted on pneumatic rubber tires for portability and has drop handles at the sides for use in placing it under the load.



Joyce piston-type air-motor jack

An Electrode Pressure Gage

An electrode pressure gage designed to measure the pressure between the electrodes of resistance-welding machines has been announced by the General Electric Company, Schenectady, New York. The gage is for use either as a standard for checking existing gages or pressure indicators on spot, line, or projection welders, or for checking the electrode pressure at the time of set-up, before proceeding with production work. It also may be used by testing laboratories for pressure determinations, or by industrials interested in checking the pressure of various kinds of springs in compression.



General-Electric electrode pressure gage

The new gage measures pressures from 0 to 4,500 lb.; an automatic stop safeguards it against damage, should pressures of more than 4,500 lb. be applied. Consisting simply of a calibrated steel yoke and a micrometer dial indicator, the gage is easily applicable to existing resistance welding machines without the need for jigs or other auxiliaries.

When electrode pressures are to be measured preliminary to production work, the gage is inserted between the electrodes so that they press on the pads on the top and bottom of the gage yoke. The electrode pressure is adjusted until the desired pressure is registered on the gage dial. The gage is then withdrawn and the welding machine placed in operation.

The dial indicator is direct reading; no calibration curves or multipliers are necessary. It has two scales, one for reading in 10 lb. intervals up to 1,000 lb., and the other to read in 1,000-lb. intervals. Each gage is carefully calibrated at the factory before shipment.

Four and One-Half-Ton Portable Hoist

The Yale & Towne Manufacturing Company, Philadelphia, Pa., has added a hoist with a capacity of 4½ tons to its line of Pul-Lift portable hoists, so that now Pul-Lifts may be had in a complete range from ¾- to 6-ton capacities. The intermediate sizes have capacities of 1½, 3 and 4½ tons.

The 4½-ton hoist has the same safety and construction features as the previous

The Yale 4½-ton Pul-lift portable hoist

models. It is about 75 per cent lighter than conventional equipment, making it easily portable. The great strength combined with the lightness of weight is due to the use of alloy steels.

This hoist will operate equally well in horizontal or vertical position. Thus it can be used for both pulling and lifting and is ideal for almost any type of main-

tenance job. It also has Yale safety hooks. In case of severe overload, these hooks open slowly, without fracture, giving ample visual warning of danger.

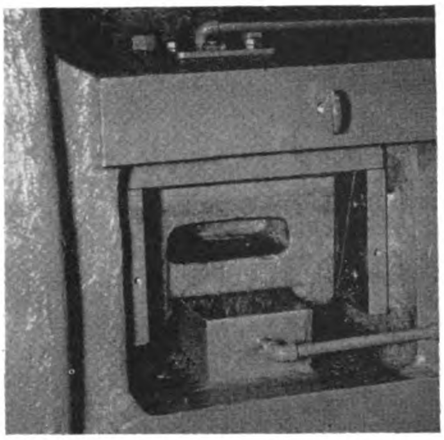
For operation in close quarters and tight out-of-the-way places, the Pul-Lift has a ratchet handle with a universal action. Short, easy strokes at any point within a complete circle permit operation in the most cramped of quarters. Possibility of flying handle is decreased to a minimum by the self-actuated load brake. As the load is increased, brake pressure increases in direct proportion.

Forging Machine Die Support

Some years ago the Ajax Manufacturing Company, Cleveland, Ohio, introduced a direct-acting air clutch in the drive of its forging machines. A recent development in this clutch is the inclusion in it of double-draft air ventilation. This provides a generous circulation of air and ample cooling throughout the clutch. It is designed to prevent overheating at the highest frequency of engagement and prolongs the life of the friction surfaces. The air enters the clutch through scoops on both sides of the flywheel hub. It is forced through the clearance between the clutch plates and out inside of the flywheel rim.

Another feature of recent development in these machines is a top-suspended outboard-guided die slide, now standard on 3-in. and larger machines. The great overall bearing length which results from the use of an outboard guide bearing located at the extreme right side of the bed frame overcomes the tendency toward cocking either horizontally or vertically and maintains the moving die in perfect match with the stationary die under the spreading pressures during heading.

The shuttle-support plate prevents the moving die from rocking under heading pressure where its backing plate support is, of necessity, cut away at the feed gap. This rugged construction successfully overcomes an inherent difficulty, particularly on large machines, and permits opening

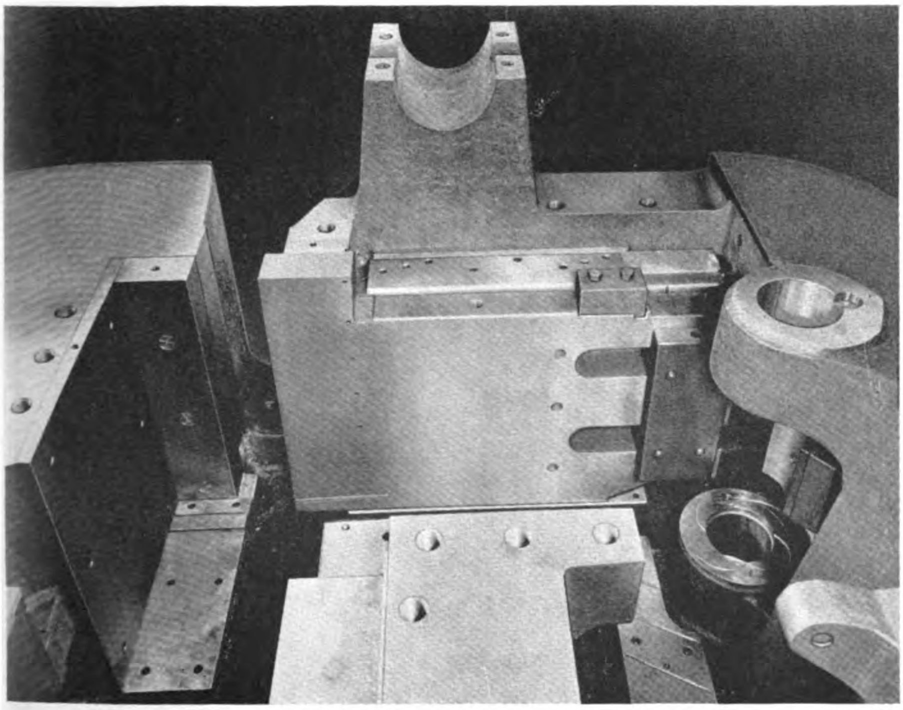


The outboard die slide support bearing is protected by shrouding ribs at both sides

up the feed gap without loss of die alignment. When in its closed position overhanging the feed gap and supporting the moving die against heading pressure, it is held positively square against the backing plate by a retaining cap at its extreme end, anchored by four through bolts directly to the bed frame.

The main portion of the slide is suspended from two long, wide lips faced with alloy-bronze bearings operating on hardened and ground steel shelf liners in the frame. These liners are full length to provide full support for the die slide throughout its entire stroke and are elevated so as to be free from the accumulation of scale and water.

A strong intermediate underarm joins the main slide body and the outboard guide bearing. The outboard bearing at the end of the underarm is located at the extreme right of the machine bed and is completely framed with heavy ribbing. The single wide and long support liner of the outboard bearing extends well toward the center of the machine and is protected from the entrance of foreign matter by shrouding ribs projecting downward from the arm at both sides of the bearing. Thus, the die slide has three points of support with the moving die carried between the bearings in such a manner as to prevent sagging and to maintain its face square with that of the stationary die.

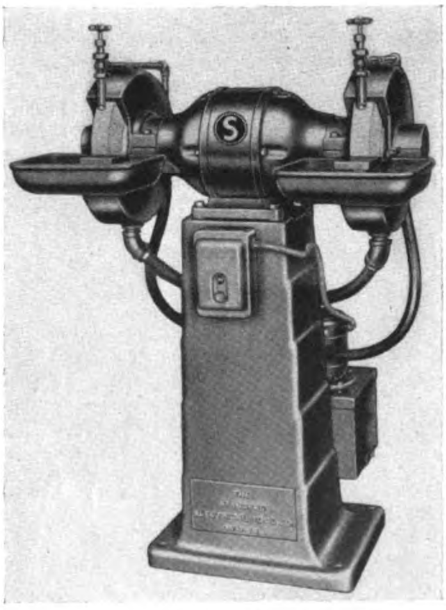


The bed frame is completely lined where the die slide and shuttle support plate operate and also at the stationary die seat with heavy steel liners for protection against localized wear or peening

Double-End Wet Grinders

Recent developments of the Standard Electrical Tool Company, Cincinnati, Ohio, are two lines of double-end wet grinders, one to accommodate grinding wheels 12 in. to 18 in. in diameter, the other for 10-in. to 14-in. cup wheels.

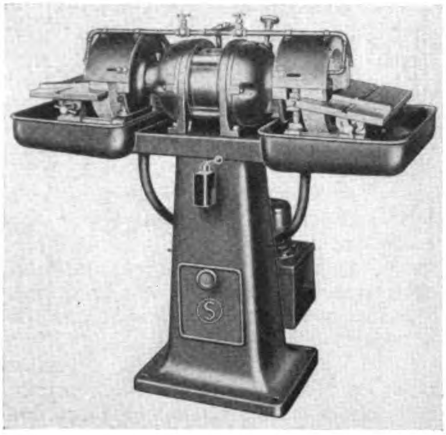
The motor sizes of the plain-wheel machines are 2 hp. to 5 hp. for operating the grinding wheels, while equipment also includes a motor-driven pump suitably mounted on the machine. The push-button starter at the front of the grinder simultaneously operates both the grinder motor and the pump motor.



Standard double-end wet grinder

Suitable hoods with integral splash bowl are furnished complete with piping for carrying water to the wheel, and a valve

to control the flow of water. The water returns by gravity to a tank. The pump has a capacity of 10 gals. per min. This



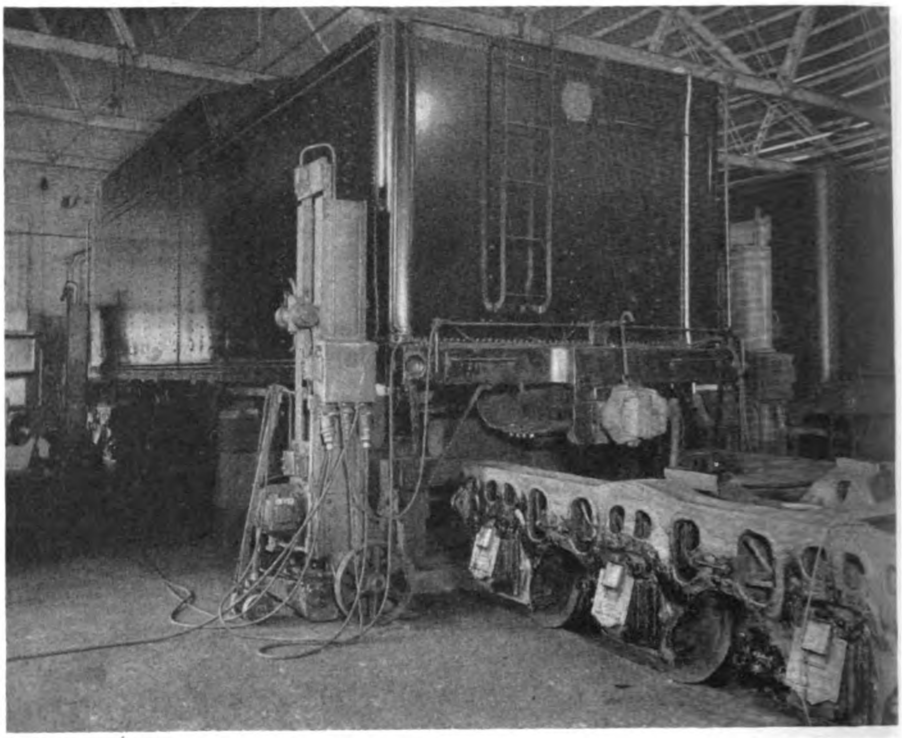
Double-end cup-wheel grinders with wet grinding attachment

machine can also be arranged as a combination wet and dry grinder if preferred.

The double-end cup-wheel grinders serve the demand for suitable grinding equipment for high-speed tool bits such as Ramet metal, Tungsten carbide, etc. The machine is made in 1-, 2-, and 3-hp. sizes, with cup wheels 10 in., 12 in., and 14 in. in diameter, respectively. Adjustable hoods compensate for wheel wear.

A graduated table permits grinding from a 30-deg. angle toward the wheel to a 45-deg. angle away from the wheel. The table extends to permit periphery grinding. It is adjustable to wheel wear and also may be raised or lowered. Equipment includes a reversing switch.

A motor-driven pump is conveniently located on the machine with a separate switch for operating the pump motor. An adjustable valve controls the flow of water for each wheel, with suitable splash bowl attached with piping for gravity return of the water. The pump has a capacity of 10 gals. per min.



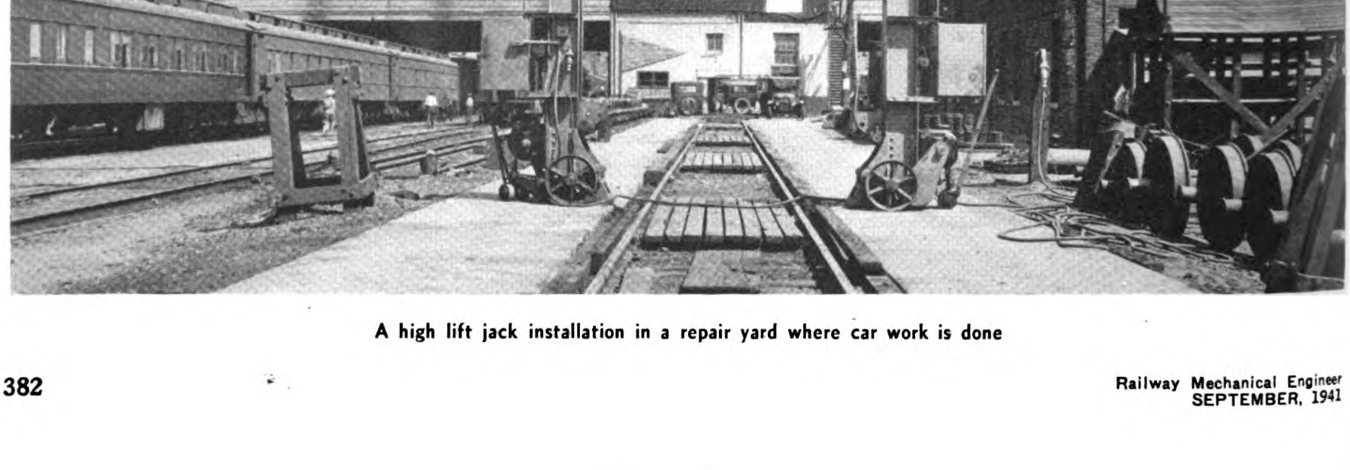
A set of four high lift electric jacks being used to lift a locomotive tender for the removal of trucks—These jacks are controlled electrically by single control

High Lift Portable Electric Jacks

One of the recent developments of the Whiting Corporation, Harvey, Ill., is the high lift, electric, portable jack which is now being used in car and locomotive shops and engine terminals for a variety of lifting jobs. These jacks are built in capacities of 20, 25 and 35 tons each. Since they are used in pairs these figures are doubled. The 20- and 25-ton models are used principally for coaches and most Diesel switchers, while the 35-ton models are for heavier work such as the Diesel-electric passenger and freight locomotives. The standard models have a hoisting speed of 9 in. per min., a low position of 2 ft. 7 in. and an effective lift of 3 ft. 11 in.

The Whiting high-lift electric portable jack is mounted on four wheels, two large rear wheels that take most of the load when the machine is being moved, and two small pivoted wheels in front for steering. These wheels form a substantial three-point support. The lifting screw supports the movable bracket used to raise and lower the load. The bracket is braced by a top roller support at the front of the machine and a bottom roller at the rear.

The base of the jack has a projecting foot which extends under the coach or locomotive a greater distance than the bracket that supports the load. For this



A high lift jack installation in a repair yard where car work is done

reason, and because of the width of the base, a safe footing is provided during raising operations.

A forked crank located near the base of the screw is brought into action when the lifting bracket reaches the lower extremity of its travel. The bracket presses the fork down, thereby forcing the two large rear wheels onto the ground and raising the toe of the base an inch above the ground, so the jack rests on the wheels. This permits the jack to be pulled along the ground to any location. When the jack is in position for lifting, the bracket is raised by the rotation of the screw, thereby disengaging the fork and freeing the wheels, so that the jack rests on its base. Any small strain adjacent to the small front wheels is absorbed by two helical springs located in a vertical position above the wheels.

Each jack is equipped with an electric motor and silent chain drive which operates the worm gearing for rotating the screw. The lifting bracket rests on a bronze jack nut through which the hoist screw passes. This nut moves up and down, depending on the direction of rotation of the hoist screw, and carries the bracket with it.

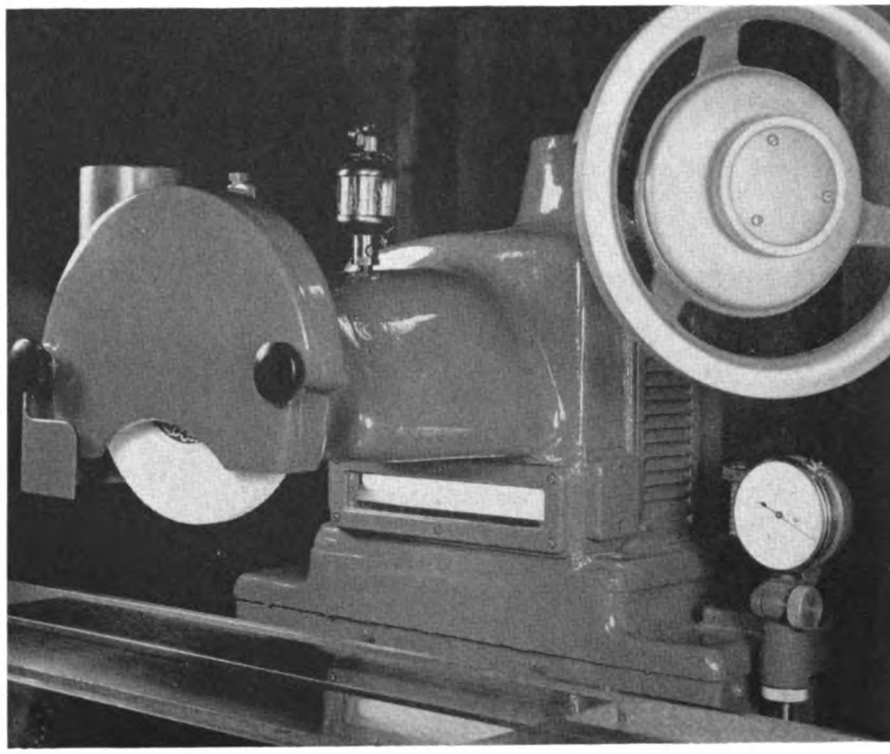
Top and bottom limit switches automatically cut out the motor for high and low limits of travel. A master control permits the operation of two or four jacks at one time from one push button station.

From a single push button control station, the operator can raise or lower any individual jack, one pair of jacks, or four jacks in unison. By using electric power, uniform speed is obtained in raising and lowering all jacks.

When the lifting bracket is in its lowest position, the base of the jack then rests on two large rear wheels and a small pair of pivoted wheels loated in front, used for steering. Thus supported, the jack can be wheeled to any location by means of a handle attached to the jack at a point between the two small pivoted wheels. The wheels are equipped with roller bearings, making it possible for one man to move the jack.

To lift one end of a car or Diesel-electric locomotive, two jacks are rolled to the vehicle—one on each side—and located usually at the ends of the bolsters. The power cable is plugged in and each jack operated separately until its lifting bracket is bearing against the jacking pad at the side sill and is taking the load. The jacks are then so connected electrically that both operate as one, and their brackets are made to elevate as one, raising the body high enough to allow the trucks to be rolled out. If other trucks are to be applied at once, the cars can rest on the jacks, since it is safer there than on the usual types of car supports.

The same course is followed when four jacks are used for raising cars, locomotives or tenders. After the load has been raised, other means may be used for supporting the load, thereby releasing the jacks for other work. The jacks may then be lowered to the point where their bases are automatically raised from the ground, placing the weight of each jack on the wheels. This allows the jacks to be pulled elsewhere for work on other equipment.



The spindle head of the Doall precision surface grinder

Precision Grinder Has Many Conveniences

In the spindle-head assembly of the new Doall precision surface grinder are several exclusive features, such as built-in flush lighting, directed where it is needed; dial indicator giving direct measurement between wheel and work in tenths; and an adjustable dust or splash guard which can be set close to the work and adjusted as the wheel wears. Precision ball bearings carried in a heat-treated forged and ground S. A. E. 3140 quill make up the heart of this assembly.

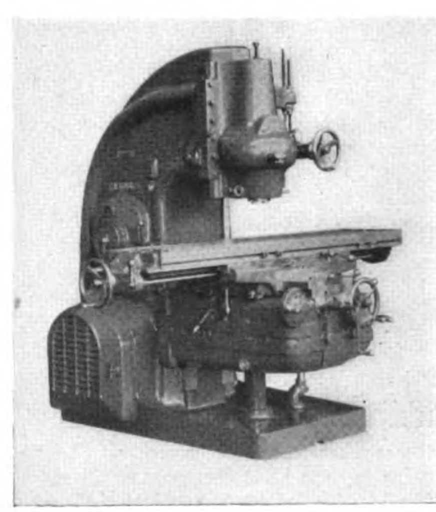
The wheel guard rotates and can be locked in any position when using a tangent-to-radius wheel dresser. The handwheel is graduated in half thousandths and has an auxiliary vernier adjustment for feeding in tenths. The handwheel is furnished in dull chrome with enamel-filled graduations to insure against rust from perspiration or coolant. The dull chrome finish also makes an ideal surface on which to mark settings with a lead pencil.

The machine is the product of Continental Machines, Inc., Minneapolis, Minn.

Improved Designs of Milling Machines

Among the recent additions to the line of Milwaukee milling machines manufactured by Kearney & Trecker Corporation, Milwaukee, Wis., are the Nos. 4K and 5H series of plain, universal and vertical machines.

The No. 4K machines are heavy-duty models, having increased range, improved controls, hydraulicly actuated starting levers which are duplicated for the front and rear, pressure lubrication and structural refinements. The working surface of the table is 82 in. by 18 in. Longitudinal power feed of 42 in. is supplied, together with 14 in. of power feed for the cross movement and 20 in. for the vertical. Twenty-four speeds are provided between 13 and 1,300 r. p. m. Rotation of the spindle is provided either forward or reverse under the control of a directional lever. Thirty-two feeds are available in a longitudinal and cross range of ¼ in. to 60 in. per min. at a vertical rate of ⅛ in. to 30 in. per min. A rapid traverse of 150 in. per min. for longitudinal and cross rate and 75 in.



One of the improved type Milwaukee horizontal millers

per min. for the vertical range is standard on these machines. These machines are powered with 15-hp. or 20-hp. motors.

Designed on the same principles of the 4K machines the No. 5H models have in-

creased working range of the table. The working surface over all is 94 in. by 18 in. Power feed ranges are provided as follows: longitudinal power feed, front and rear control 52 in.; cross power feed, front and rear control 16 in.; and vertical power feed, front and rear control 20 in. The horizontal types of Model H machines are nearly 71 in. high, while the vertical model is 89 in. high. The double overarms on horizontal machines consist of two solid steel bars each 5¾ in. diameter. There are twenty-four speeds ranging from 13 to 1,300 r. p. m. and 32 feeds in the longitudinal and cross ranges from 1.4 in. to 60 in. per min. at a vertical rate of ⅛ in. to 30 in. per min. Lubrication for the column and knee, and for the dividing head on vertical machines, is taken care of by individual oil pumps located in these respective parts.

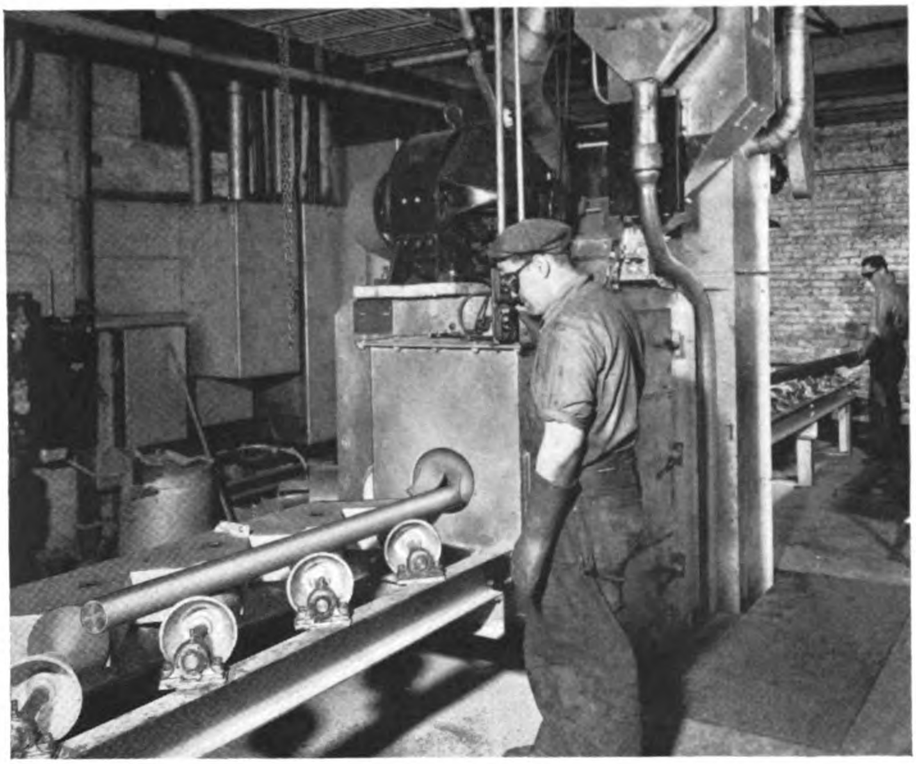
Flue Cleaner Requires No Air

A simplified flue cleaning machine known as the Ryerson-American-Wheelabrator is now available through Joseph T. Ryerson & Son, Inc., Chicago. It is a fast cleaning unit requiring no air pressure, thereby eliminating the most costly factor in operating blasting equipment. Essentially the machine consists of an enclosed cabinet, an abrasive throwing unit, an abrasive cycling system, and a conveyor to carry the flues through the blast.

The blasting unit consists of a bladed wheel revolving at high speed to throw metallic abrasive against the work at the most advantageous cleaning angle. After being expelled against the boiler flues, the abrasive is cycled through the machine to a hopper, directly above for subsequent return to the unit.

Flues are carried through the blast on dished, skewed-roll conveyors which rotate the flues and advance them through the blast at a controlled rate of speed. The conveyor is equipped with a variable-speed drive so that the speed of travel through the blast can be varied according to the scale condition on the tubes. Under a normal scale condition, the flues are cleaned at a speed of approximately 20 to 30 ft. per min., at which the average length of boiler flue can be cleaned in less than one minute. The simplicity of the cleaning method and the speed of cleaning is said to make it possible for each boiler flue to be kept in good condition at low cost.

The new machine is furnished complete with necessary exhaust fan, dust cleaning units, dust bags and power shakers.

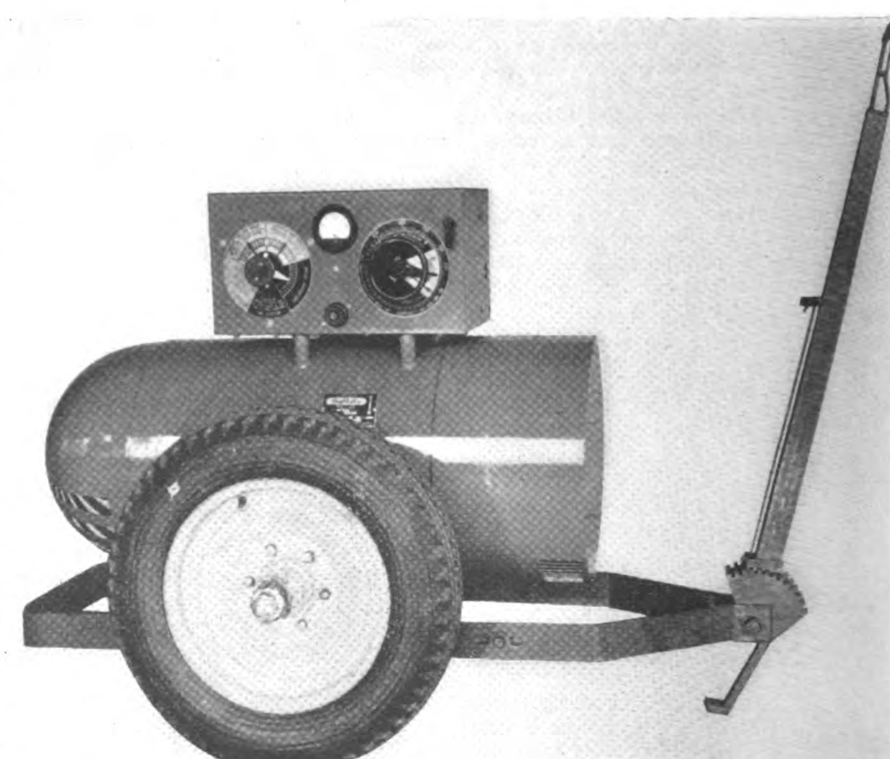


Flues are cleaned with metallic abrasive at a speed of 20 to 30 ft. per min.

A Portable Electric Welder

The photograph shows a two-wheel, lightweight pneumatic-tired trailer for mounting arc-welding machines to permit easy, fast portability in the shop or yard which has recently been introduced by the Lincoln Electric Company, Cleveland, Ohio.

Designed for mounting either Lincoln S. A. E. 200- to 600-ampere a.c. motor-driven or type SA-200 special engine-driven arc welders, the new unit can be hitched to an industrial truck or moved readily by hand by virtue of its low underslung construction, narrow 31-in. tread and method of balancing. Mounting is readily accomplished by means of four bolts in the frame of the trailer which register with holes in lugs on the welding machine. A hand-operated ratchet arrangement for locking the support arm in position is provided in the combination tow bar and standing support.



Light two-wheel trailer for Lincoln welder

(*Turn to next left-hand page*)

High Spots in
Railway Affairs . . .

St. Lawrence Project

The Administration is apparently determined to have its way with the St. Lawrence seaway and power project. The latest movement, made at the request of President Roosevelt, is to include it in the Rivers and Harbors Bill. The President, in asking that this procedure be followed, said, "You know how I had counted upon getting the St. Lawrence project started this year, in order to get power as soon as possible for the defense program. I have come to the conclusion that the best way to expedite the matter is to include it as one of the projects in the Rivers and Harbors Bill." Dr. Julius H. Parmelee, director of the Bureau of Railway Economics of the Association of American Railroads, told the House Rivers and Harbors Committee that, "If the project was completed, railroad revenues would decline at least $105,000,000 a year, due to direct diversion of traffic to the waterway and to the drop in coal tonnage shipped by rail." J. G. Luhrsen, executive secretary of the Railway Labor Executives Association, advised the committee that the project has "every element of preponderance of evil, rather than good, for the American people as a whole."

Transport Board Confirmed

The Transportation Act of 1940 provided for the appointment by the President of a Transport Board to study and report on the various types of transportation with a view to using them in such a combination as to develop an adequate national transportation system. The President named a board on March 20. The Senate was not impressed by the personnel and took no action. On April 29 the President withdrew the name of Wayne Coy, and again, on July 24, that of Charles West, but leaving for consideration by the Senate the name of Nelson Lee Smith, chairman of the New Hampshire Public Service Commission. At the same time he nominated C. E. Childe of Omaha, Neb., and Robert E. Webb, chairman of the Kentucky Railroad Commission. These nominations were confirmed by the Senate on August 11. While Messrs. Smith and Webb have had no experience on the practical side of transportation, they have served several years each on their respective state commissions, and have the reputation of being hard workers and conscientious public servants. Smith got his start as a college teacher of economics and Webb as a lawyer. C. E. Childe started on the Chicago, Burlington & Quincy as a station helper, telegraph operator and clerk. Later he was accociated with the traffic bureaus of the Chambers of Commerce of Omaha and Sioux City. He has been active in the National Industrial Traffic League, serving at one time as its president. Since 1934 he has been engaged in private practice as a transportation counsel. For many years, however, he has been closely identified with the inland waterway interests. Senator Reed, of Kansas, opposed his confirmation strongly because "he has been a traffic adviser and lobbyist for inland waterway interests and has shown bias and prejudice in hearings before our committee, which are of record."

Continuous Welded Rail

In a paper before the Metropolitan Maintenance of Way Club, P. O. Ferris, chief engineer, Delaware & Hudson, reviewed the experience of that road with continuous welded rail. The first installations were made seven years ago. Among other advantages it reduces the cost of track maintenance, lengthens the life of the rail, eliminates the necessity of bonding joints and makes for better conductivity in track circuits, insures smoother riding track and lowers the cost of maintaining alinement and surface.

Wheat Movement

The railroads have been disappointed at the amount of wheat movement they have been asked to handle. They have had ample cars available, but the storage facilities throughout the country are jammed with the carry-over from last year's harvest and this year's early crop. The Car Service Division, therefore, has been forced to place embargoes on the movement of wheat. In explaining this, in the case of the Pacific Northwest, it announced, "This is a defense measure. We cannot permit cars needed for defense traffic to be used as wheat warehouses. The normal movement of grain is not affected, as there is no ban on grain that is sold and can be moved. The government is in full accord with the plan and the northwest mills and grain interests have requested the embargo." The wheat crop in the state of Washington is double its normal size; at one of the wheat growing centers in the state, Lind, it is said there are more than 100,000 bushels of wheat piled on the ground because of lack of storage space.

Railroad Employees Contribution to British

As the months have passed, the movement by railway employees to raise funds for the British war relief has grown steadily and rapidly. Employees of the Central Railroad of New Jersey have provided five ambulances, the Reading Company a substantial number, the St. Louis-San Francisco two, and at present a drive is on among the employees of the Lehigh Valley to contribute one per cent of their salaries for one month. According to Mrs. W. A. Deems, assistant executive secretary, British-American Ambulance Corps, New York, the credit for the largest single donation from any one railroad goes to the Baltimore & Ohio. Its total contribution has exceeded $78,000. Of this amount $65,000 was expended for a flying ambulance, which was dedicated on May 19. In addition a home has been provided for evacuated children at St. Just, Cornwall, and 500 radio sets have been supplied for British railroad employees on duty at lonely and isolated points.

Washing Machines

What would it mean if there was a power-driven washing machine in every family in the United States? Or any one of a number of similar useful labor-saving devices? When we get caught up on the production of materials and equipment for our national defense program and war supplies, we must find ways and means of keeping our people employed, but not at the expense of the taxpayer—he will have more than he can do in settling the public debt incurred on so colossal a scale in these recent years. Yet there will be ample plant capacity and available power and materials, and skilled and semi-skilled labor to provide for the comfort and convenience of all of our people if we can make the best use of these facilities. It involves low cost production and cheap and efficient means of transportation and distribution. It would seem also to require a more even distribution of the national income. It is no simple problem. and yet American ingenuity should be able to find a reasonable solution; as a matter of fact, we have been making slow but steady progress in the right direction for several decades. It must be on another basis, however, than the building of more and more public works and the further piling up of our national debt. The best minds in America—not politicians, but statesmen, businessmen, industrialists, financiers, engineers, economists, etc., should be put to work on the task.

(*Turn to next left-hand page*)

NEWS

No Mechanical Division Meeting in 1942

In view of present heavy demands on the time of mechanical department officers in performing duties on their individual roads and the probability that these demands will be intensified in the ensuing months, it has been deemed expedient to eliminate the annual meeting of the Association of American Railroads, Mechanical Division, for 1942. In place thereof, there will be a meeting of the general committee and the chairmen of standing committees.

All Steel Under Full Priority Control

Steel in all its forms, including alloy steel, was placed under full priority control on August 9 in an order issued by E. R. Stettinius, Jr., director of priorities, Office of Production Management. Because the basic provision of the order is "that all defense orders must be filled ahead of non-defense orders," officers of the Association of American Railroads expect that one result will be an improvement in the situation with respect to deliveries of steel to car builders whose operations have been curtailed by shortages.

With the A-3 rating assigned them, materials for cars and locomotives qualify as defense materials at a relatively high place on the scale; anything with a rating of A 10 or higher is called a defense order. As the OPM statement put it, "defense orders include contracts or orders for the Army or Navy, for certain other government agencies, for Great Britain or any other lend-lease country, or any order to which a preference rating of A-10 or higher is assigned."

As noted above, the order places all iron and steel products under mandatory priorities; and while alloy steels are thus included, a separate order will be issued giving details of the regulations applying to alloys. A similar order putting pig iron under full control was issued August 6. The steel order contains a six-point formula providing for the acceptance of defense orders. Among other things the producers must file monthly reports with the Division of Priorities. If defense orders are rejected or delivery is delayed unreasonably, the customer may bring those matters to the attention of the Division. Effective September 1, purchase orders for steel must be accompanied by a special form (PD-73) obtainable from steel producing companies setting forth the purpose for which the ordered material will be used. The Director of Priorities may direct producers to make deliveries of steel in fulfillment of special defense needs; he may require them to modify production schedules; and he may allocate purchase orders to particular producers.

In line with the A. A. R. view mentioned at the outset, it was stated at OPM that one effect of the order was expected to be a more speedy release of plates to builders of railway equipment. In this connection OPM's Division of Production announced on August 7 that OPM Director General Knudsen had recommended to Federal Loan Administrator Jones federal financing for the construction of a 780,000-ton plate mill at the Sparrows Point, Md., plant of the Bethlehem Steel Company. Eugene G. Grace, president of Bethlehem, the announcement said, "submitted the program to OPM as a partial solution of the critical plate situation growing out of the naval and merchant ship construction programs, railroad car building, and other defense undertakings."

Meanwhile Priorities Director Stettinius has also announced a new Maintenance and Repairs Rating Plan to assure "a steady flow of maintenance and repair parts to essential industries." The plan is applicable at once to nine industries, including the railroads, and "common carrier passenger transportation by urban, suburban, and interurban electric railways." As noted in the August *Railway Mechanical Engineer*, page 329, the Office of Price Administration and Civilian Supply had previously promulgated an allocation program covering repair and maintenance materials for 26 industries including the railroads.

Under the OPM plan, the repair materials will get an A-10 rating, which, as noted above, is the lowest in the defense category. However, a special emergency rating of A-1-a may be assigned "in cases of extreme emergency," but only when telegraphic applications have been granted; and such applications will be granted "only in especially urgent cases, such as sudden breakdown, accident, fire or storm damage. The A-10 rating available on the repair parts will not come automatically; it must be applied for on Form PD-67. Moreover, it can be applied only to deliveries of maintenance and repair parts, and may not be used to obtain materials flowing into production, "excess" inventories of parts, or materials for plant expansion.

B.&.O. Inaugurates Diesel Service to Detroit

Following initiation and christening ceremonies, the newly equipped Ambassador train of the Baltimore & Ohio left Detroit, Mich., on July 29, on its initial run to Washington, D. C., powered with a 4,000-hp. Diesel-electric locomotive, built by the Electro-Motive Corporation, subsidiary of General Motors. This is believed to be the first use of a Diesel-electric passenger locomotive in the state of Michigan and the employment of this type of power on the Ambassador is accom-

(*Continued on next left-hand page*)

R. B. White, president of the Baltimore & Ohio, personally took delivery of the new 4,000-hp. Diesel-electric locomotive from the Electro-Motive Corporation

panied by a 30-min. reduction in running time between Detroit and Washington.

Preceding the dedication, a luncheon was held at the Hotel Statler, Detroit, attended by about 400, including state and city officials, representatives of the business interests of the city and executive officers of the Baltimore & Ohio, General Motors and the Electro-Motive Corporation. The two principal addresses were made by R. B. White, president, Baltimore & Ohio, and C. F. Kettering, vice-president, General Motors.

The christening exercises were conducted at the Fort St. Union Depot, where Helene Prescott, 9-year-old daughter of Frank Prescott, Electro-Motive vice-president, named the locomotive "Ambassador."

A.C.F. Turns Out 1000th Tank

The American Car and Foundry Company, on August 2, celebrated the production of its 1,000th 12-ton light combat tank with a parade and sham battle at Berwick, Pa. Fifty-five hundred employees marched in the parade which was led by the 1,000th tank dressed in white enamel. Twenty-nine fife and drum corps from Berwick and surrounding towns supplied martial music.

After the parade the tank was turned over to the Army by Charles J. Hardy, president of the American Car and Foundry Company. A sham battle was then staged at the Berwick airport field. Fifteen tanks participated in a realistic combat in which a fort and a number of pillboxes were destroyed. The car manufacturing company is now rolling off these 12-ton tanks at the rate of 14 per day, or one every 45 min. To provide facilities for manufacture of tanks, the American Car and Foundry Company financed the expansion of its plants to the extent of $3,000,000, including addition of 32 furnaces for the heat-treating of armor plate. The original order for 329 tanks was completed two weeks ahead of schedule. Total orders, including a recent one for 629, comprise 4,685 light combat tanks.

OPACS Allocation Program for Air-Conditioning Refrigerant

Allocation of available supplies of Freon refrigerant gases to users and manufacturers of civilian refrigeration and air-conditioning equipment, "including railroad cars," is directed in a program announced August 19 by the Office of Price Administration and Civilian Supply. "Heavy defense needs for this basic chemical have caused a shortage in many of its derivatives," the OPACS announcement said.

A senior classification is assigned in the program to maintenance of all types of refrigerating equipment now operating and existing air-conditioning equipment in hospitals, clinics, and sanitoria requiring Freon refrigerants. Maintenance of industrial air-conditioning equipment already installed, including that of the railroads, ranks next in preference, followed by main-

(*Continued on next left-hand page*)

Orders and Inquiries for New Equipment Placed Since the Closing of the August Issue

Locomotives

Road	No. of Locos.	Type of Loco.	Builder
Atchison, Topeka & Santa Fe	15[1]	5,400-hp. Diesel-elec.	Electro-Motive Corp.
Belt Ry. of Chicago[2]	1	1,000-hp. Diesel-elec.	American Loco. Co.
Central of Georgia	1	1,000-hp. Diesel-elec. sw.	Electro-Motive Corp.
	1	600-hp. Diesel-elec. sw.	
Central of New Jersey	2	1,000-hp. Diesel-elec.	Electro-Motive Corp.
	2	600-hp. Diesel-elec.	
	4	600-hp. Diesel-elec.	Baldwin Loco. Wks.
	2	600-hp. Diesel-elec.	American Loco. Co.
Chicago, Milwaukee, St. Paul & Pacific	2	44-ton Diesel-elec. sw.	General Electric Co.
Crucible Steel Co.	1	58-ton fireless	Heisler Loco. Wks.
Louisville & Nashville	8	4,000-hp. Diesel-elec. pass.	Electro-Motive Corp.
	14	2-8-4 steam	Baldwin Loco. Wks.
Mysore Iron & Steel Works of India	1	2-8-2 steam	Baldwin Loco. Wks.
Newburg & South Shore	3	660-hp. Diesel-elec.	American Loco. Co.[3]
	1	1,000-hp. Diesel-elec.	
New York, Susquehanna & Western	2	1,000-hp. Diesel-elec.	American Loco. Co.
Norfolk & Western	10[4]	2-8-8-2 steam	Company shops
Patapsco & Black Rivers	1	1,000-hp. Diesel-elec.	Baldwin Loco. Wks.
	1	660-hp. Diesel-elec.	
Pennsylvania	1	Steam-turbine-pass.	Company shops
	1	Steam freight	
Philadelphia, Bethlehem & New England	1	1,000-hp. Diesel-elec.	Electro-Motive Corp.
Richmond, Fredericksburg & Potomac	6	4-8-4 steam	Baldwin Loco. Wks.
St. Louis-San Francisco	5	1,000-hp. Diesel-elec. sw.	Baldwin Loco. Wks.
Southern Ry. System:			
Southern Ry.	2	1,000-hp. Diesel-elec. sw.	Electro-Motive Corp.
	1	660-hp. Diesel-elec. sw.	American Loco. Co.
Cincinnati, New Orleans & Texas Pacific	7	1,000-hp. Diesel-elec. sw.	Electro-Motive Corp.
	3	1,000-hp. Diesel-elec. sw.	American Loco. Co.
	2	660-hp. Diesel-elec.	
Alabama Grt. Southern	3	660-hp. Diesel-elec. sw.	American Loco. Co.
New Orleans Terminal	2	1,000-hp. Diesel-elec. sw.	Electro-Motive Corp.
Terminal R. R. Assn. of St. Louis.	3	1,000-hp. Diesel-elec.	American Loco. Co.
	2	660-hp. Diesel-elec	
	3	1,000-hp. Diesel-elec.	Baldwin Loco. Wks.
	2	660-hp. Diesel-elec.	
Union Pacific	25[5]	1,000-hp. Diesel-elec. sw.	Electro-Motive Corp.
Union Railroad	4	1,000-hp. Diesel-elec.	Baldwin Loco. Wks.
United States Army	1	45-ton Diesel-elec.	General Electric Co.
	2	44-ton Diesel-elec.	
Wabash	1	600-hp. Diesel-elec. sw.	Electro-Motive Corp.
	1	600-hp. Diesel-elec. sw.	Baldwin Loco. Wks.

Freight Car Orders

Road	No. of Cars	Type of Cars	Builder
Akron, Canton & Youngstown	15	70-ton covered hopper	American Car & Fdy. Co.
Atlantic Coast Line	30	50-ton auto box	Pull.-Std. Car Mfg. Co.
Burlington Refrigerator Express Co.	300	Refrigerator	Company shops
Chicago & North Western	675	50-ton box	Pull.-Std. Car Mfg. Co.
	700	50-ton box	American Car & Fdy. Co.
	250	Ore	Bethlehem Steel Co.
Chicago, St. Paul, Minneapolis & Omaha	500	50-ton box	Gen. Amer. Trans. Corp.
Cincinnati, New Orleans & Texas Pacific	2	Depressed-center flat	Company shops
Denver & Rio Grande Western	10	Caboose	Bethlehem Steel Co.
du Pont, E. I., de Nemours & Co.	100	11,000-gal. tank	American Car & Fdy. Co.
Fruit Growers Express Co.	900	Refrigerator	Company shops
Lehigh Valley	12	Cabooses	Company shops
Minneapolis, St. Paul & Sault Ste Marie	5	70-ton covered hopper	American Car & Fdy. Co.
Missouri & Arkansas	100	50-ton box	American Car & Fdy. Co.
New York, Chicago & St. Louis	250	50-ton drop-end gondolas	Greenville Steel Car Co.
	100	50-ton auto	Ralston Steel Car Co.
South African Rys. & Harbours	1,000	Gondolas	Canadian Car & Fdy.
United States Army	...	Dump cars	Western-Austin Co.
	500[6]	Tank	Gen. Amer. Trans. Corp.
	16	50-ton flat	Haffner-Thrall Car Co.
United States War Dept.	29	40-ton fire control	Greenville Steel Car Co.

Freight-Car Inquiries

Road	No. of Cars	Type of Cars	Builder
Chicago Great Western	200	50-ton merchandise	....
National Rys. of Mexico	1,000[7]	50-ton box	....

Passenger-Car Orders

Road	No. of Cars	Type of Car	Builder
Pullman Co.	6	Sleeping	Pull.-Std. Car Mfg. Co.
United States War Dept.	2	Hospital	Haffner-Thrall Car Co.

Passenger-Car Inquiries

Road	No. of Cars	Type of Car	Builder
National Rys. of Mexico	16	First-class coach	....
	64	Second-class coach	....
	40	Express-baggage	....

[1] Total estimated cost, $7,000,000. Each of the 15 locomotives will comprise four sections of 1,350-hp. each. These locomotives are in addition to five 5,400-hp. units for this road, two of which were ordered last year and are now in service, and three of which were ordered earlier this year and are now being delivered. When the additional 15 units are placed in service, the Santa Fe will have a fleet of Diesel-electric freight locomotives having a combined total of 108,000-hp.

[2] The company has also received delivery of one 600-hp. Diesel-electric locomotive from the same builder.

[3] Delivery received.

[4] These are in addition to six locomotives of the same class ordered in March but not reported in the *Railway Mechanical Engineer*. The company is now working on five Class J passenger locomotives of the 4-8-4 type, ordered in December, 1940, which it expects to complete between now and late 1941 or early 1942. The 16 Mallet engines will be turned out at the rate of about one per month thereafter.

[5] Each of the locomotives will be nearly 45-ft. long, weigh 125 tons and be equipped with one General Motors Diesel engine of twelve cylinders. Delivery is expected at the rate of six locomotives per month beginning in April, 1942. Cost of the order is estimated at about $2,000,000.

[6] Cost, $1,287,000.

[7] In addition to 1,000, order for which was noted in the August issue.

tenance of other air-conditioning equipment, then by manufacture of new refrigeration and air-conditioning equipment. "Current supplies of Freon," OPACS said, "are expected to be adequate for the maintenance of all installed refrigeration and air-conditioning equipment, but some deliveries for new units may have to be deferred until the summer ice cream and air-conditioning season is passed."

Management and Labor to Cooperate with OPM

THE railroads and railroad labor will cooperate with the Office of Production Management in meeting a shortage of skilled men in defense industries to the extent that they can do so without impairing the ability of the railroads to meet essential demands of transportation, according to a joint announcement issued on July 29 by J. J. Pelley, president of the Association of American Railroads, and B. M. Jewell, president of the Railway Employees Department of the American Federation of Labor.

Following meetings between representatives of the O. P. M., of the railroads, and of the railroad labor organizations most concerned, continues the announcement, Sidney Hillman, associate director of O. P. M., has been advised that the railroads and railroad labor will do what they can to help the general defense movement, keeping in mind their "first duty to make sure that there is no shortage of railroad transportation during this emergency."

In a statement issued after the meetings, which were held in Chicago on July 22, Ralph Budd, transportation member of the National Defense Advisory Commission, opposed the proposed transfer of some 100,000 railroad mechanics to the shipbuilding and aircraft industries. Mr. Budd's statement is elaborated in another item in this issue.

The joint statement goes on to say that Mr. Pelley and Mr. Jewell have placed the situation before the individual railroads and the local organizations of the railroad crafts affected, to determine what can be done in each individual situation toward releasing to defense industries fully skilled men, with proper protection of their employment rights on the railroads.

In discussions with the railroad representatives, continues the statement, Eli L. Oliver, representing the labor division of OPM, made it clear that there was no intention to interfere with the ability of the railroads to continue to perform their transportation work, which is looked upon by the labor division of the OPM as being as essential to the defense program as the Army and Navy. However, says the statement, Mr. Oliver stated that the prospective shortage of 1,400,000 skilled men in defense industries has made it necessary to call upon other industries, essential as well as non-essential, to help out by permitting highly skilled men to leave their service temporarily for defense work, with protection of their seniority and other employment rights.

The position taken by the railroads and the railroad employees, concludes the statement, is in keeping with their joint program of aid to national defense, adopted in June, 1940, at the very beginning of the defense movement, in anticipation of possible future shortages of skilled labor in industries manufacturing defense essentials.

R. L. Kleine Receives 50-Year Button

To mark completion of a half century of service with the Pennsylvania, Rudolph L. Kleine, assistant chief of motive power—car, with headquarters at Philadelphia, Pa., was presented with a 50-year gold button on August 18 by H. W. Jones, chief of motive power. Mr. Kleine's entire service has been spent in motive-power work and nearly all of it has been devoted to the design, construction and repairing of freight and passenger cars. After finishing his

R. L. Kleine

education at the Philadelphia Manual Training High School and at Drexel Institute, he entered the service of the Pennsylvania at Philadelphia on August 17, 1891, in the office of the superintendent of motive power of the Philadelphia, Baltimore & Washington, now the Southern General division. He was later appointed draftsman, and after being transferred to freight- and passenger-car repair work in the Wilmington (Del.) shops was promoted to foreman in 1900. He became general foreman of the Maryland division the following year, and one year later was transferred to Altoona, Pa., where he served successively as general car inspector, assistant chief car inspector and chief car inspector. He was appointed assistant chief of motive power—car, of the Pennsylvania, with headquarters in Philadelphia, on March 1, 1920.

A.A.R. Policy on Inspecting and Photographing Rail Facilities

J. J. PELLEY, president of the Association of American Railroads, has written to executives of member roads a letter answering some of the more important questions which have come up in connection with the A. A. R. circular letters of February 19 and March 26 with reference to the presence of unauthorized persons upon railroad property, the photographing of railroad facilities, and the like.

Mr. Pelley's letter, dated July 15, states that the declared policy was not intended to discourage the operation of excursions of the rail-fan type, "provided such excursions do not include inspection of vital facilities such as shops, freight terminals, docks, and the like."

With respect to inspection by the public of new passenger trains, new passenger stations and other facilities and equipment intended for public use, Mr. Pelley said "it was not the intention to suggest that there be any restrictions as to visiting facilities such as are commonly open to the public." Another question answered by Mr. Pelley was: "Is there any objection to reliable publications taking general ground views of railway installations, operations and equipment which are not of a vital nature?" His answer is: "From the proper authorities here in Washington, we are assured that there is no objection to the taking of such pictures by reliable publications. We are further advised, however, that the indiscriminate taking of photographs of railroad facilities, such as yards, shops, tunnels, bridges and other vital areas is not desirable and should not be permitted."

Railroad Mechanics Can't Be Spared Says Budd

RALPH BUDD, transportation commissioner of the National Defense Advisory Commission, believes that railroad mechanics can make their best contribution to national defense by staying in railroad shops instead of going to the shipbuilding and aircraft industries. This view was expressed by Mr. Budd after a conference of railroad officers and railroad labor leaders called by Sidney Hillman, associate director general of the Office of Production Management, on July 22 at Chicago, "to consider the integration of railroad maintenance employees into the national defense labor program."

"I have never heard of a suggestion more threatening to the transportation structure during the defense emergency," declared Mr. Budd, in commenting on Mr. Hillman's suggestion that some 100,000 of the railroads' 400,000 maintenance workers be transferred to the shipbuilding and aircraft industries. "Railroads," he continued, "not only cannot sacrifice manpower at this time but they need every available mechanical service if they are to escape being crippled."

Mr. Budd then proceeded to point out that the railroads had taken more of the transportation burden than anyone thought they could, due largely to the taking off of intercoastal and intracoastal ships and the large increase in the amount of iron ore being hauled. Moreover, said the Burlington president, the carriers are being hard-pressed because of their inability to get new cars on order due to the difficulties of the car builders in obtaining the necessary steel.

As an alternative, Mr. Budd suggested

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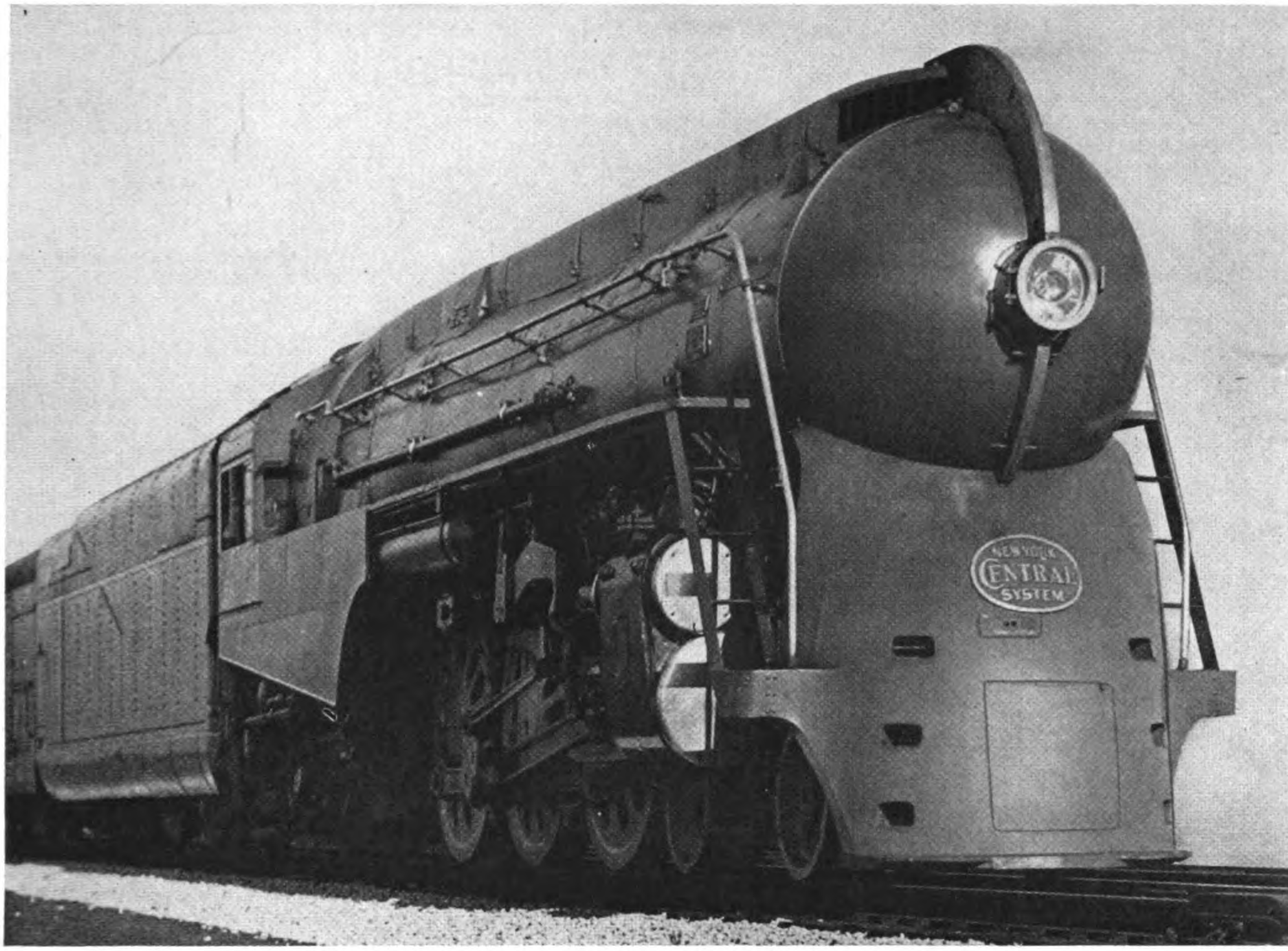

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that it would be better to take mechanics from another field of transportation, the motor car industry, than to take them from the railroads. These mechanics, he declared, could be just as easily trained for shipbuilding and aircraft work as could the railroad mechanics, and the transfer would be much less dangerous to the welfare of the country and the defense program.

The conference, according to Mr. Budd, who did not attend, took no action of any kind, but railroad representatives were united in demanding that no attempt be made to divert their employees to any other industry at this time when railroad facilities are being taxed to the utmost.

Equipment Purchasing and Modernization Programs

Atchison, Topeka & Santa Fe.—The Santa Fe has applied to the Interstate Commerce Commission for authority to issue $20,000,000 of equipment trust certificates, Series E, to be sold through competitive bidding at not less than par and accrued dividends at a rate to be stated in the bid. Proceeds will finance in part the acquisition of equipment estimated to cost $25,000,000, including 3,975 freight cars, sixteen 5,400-h.p. Diesel-electric freight locomotives and four 1,350-h.p. Diesel-electric freight locomotive sections, and 59 lightweight passenger-train cars. The certificates will mature serially over a 10-year period—$2,000,000 on each September 10 from 1942 to 1951.

Atlantic Coast Line-Louisville & Nashville.—These roads have asked the Interstate Commerce Commission for authority to assume liability for $1,720,000 of equipment trust certificates of the Clinchfield, maturing in 10 equal annual installments of $172,000 on August 15 in each of the years from 1942 to 1951, inclusive. The proceeds will be used as part of the purchase price of new equipment costing a total of $1,917,195 and consisting of eight steam, 4-6-6-4 freight locomotives; five all-steel, 34 ft. 3 in., covered hopper cars of 70 tons capacity; and seven all-steel 29 ft. 2 in., eight-wheel caboose cars.

Chesapeake & Ohio.—The C. & O. has asked the Interstate Commerce Commission for authority to assume liability for $4,300,000 of equipment trust certificates, maturing in 10 equal annual installments of $430,000 on August 1 in each of the years from 1942 to 1951, inclusive. The proceeds of the certificates, which will bear interest at a rate not to exceed three per cent, will be used as part of the purchase price of new equipment costing a total of $5,454,190, and consisting of 1,000 50-ton, 40 ft. 6 in., all-steel box cars, and 1,000 50-ton all-steel hopper cars.

The C. & O. also plans to ask for bids for the construction of car repair facilities and additional test tracks at Newport News, Va., at estimated cost of $133,815 and for additions and alterations to warehouses at Norfolk, Va., at estimated cost of $75,000.

Denver & Rio Grande Western.—A contract amounting to $48,825 has been awarded the F. W. Miller Heating Company, Chicago, for the installation of a direct steaming system and remodeling the boiler washing system at Salt Lake City, Utah. Plans are also being made for the construction of inspection pits for streamlined Diesel-powered trains at two important terminals at an estimated cost of $54,000.

Missouri Pacific.—The Missouri Pacific has been authorized by the District court to purchase 2,850 freight cars as follows:

	For Missouri Pacific
750	50-ton, 40½-ft. box cars
250	50-ton, 50½-ft. box cars
500	70-ton hoppers
50	70-ton drop end coal cars
50	50-ton flat cars
	For Missouri-Illinois
100	50-ton box cars
50	50-ton low side flat bottom coal cars
50	55-ton covered hoppers
	For Gulf Coast Lines
250	50-ton box cars
400	50-ton low side flat bottom coal cars
50	50-ton flat cars
	For International-Great Northern
100	50-ton box cars
200	50-ton low side flat bottom coal cars
50	50-ton flat cars

Missouri-Kansas-Texas.—The M-K-T 2,000-car rehabilitation program, reported in the August issue of the *Railway Mechanical Engineer*, page 331, has been supplemented with a program calling for the rebuilding of an additional 500 box cars, the repair of 200 coal cars, the construction of 60 caboose cars and the rebuilding of 52 company fuel oil tank cars.

New York Central.—The N. Y. C. is reported to be considering the purchase of some new passenger-train cars and the overhauling of about 100 coaches.

New York, New Haven & Hartford.—Wet sand-handling equipment for steam driers at the Cedar Hill enginehouse at New Haven, Conn., has been purchased from the Ross & White Co., Chicago.

A contract has been awarded to the Foskett & Bishop Co. of New Haven, Conn., for the construction of fueling facilities for Diesel-electric locomotives at New Haven at estimated cost of $21,000.

Union Pacific.—The Truscon Steel Company, Youngstown, Ohio, has been awarded a contract for the construction of three steel buildings at the Cheyenne (Wyo.) shops, which will cost approximately $465,000 and will replace those destroyed by fire on May 19. The new buildings will consist of a 100-ft. by 176-ft. mill shop, a 96-ft. by 264-ft. wheel and tank shop, and a 40-ft. by 66-ft. grease house with basement.

"400" Diesels Completed 1,200,000 Miles

The Diesel-electric locomotives which haul the "400" of the Chicago & North Western between Chicago and Minneapolis, Minn., completed 1,200,000 miles of virtually uninterrupted service on July 1. During the 24 months that they have been in service they, with one exception, have not missed a single trip. This exception was one trip missed by one unit when it was held up for minor repairs. The locomotives were placed in operation on June 1 and 14, 1939, and since have been used on the "400" and the North Western Limited. On the "400" they operate on a schedule of 6¾ hr. for the 407 miles and on the North Western Limited on a schedule of 9¼ hr., with the result that, with the three hours in which they travel between the station and the yard at the terminals, they are in motion 19 hours out of 24 each day. On May 31, 1941, they had completed an official combined mileage of 1,144,799 miles.

Supply Trade Notes

E. J. Kunsman, formerly with the Southern Pacific at Houston, Tex., has been appointed sales engineer of the Holland Company, with headquarters at Chicago.

◆

B. F. Goodrich Company.—*L. L. Horchitz* has been appointed manager of the recently revised Los Angeles, Cal., district of the mechanical goods division of the B. F. Goodrich Company. *H. A. Shultz* has been appointed branch manager at San Francisco, to succeed *W. D. Rigdon*, who has retired, and *C. M. Christensen*, manager of the Denver, Col., district, to succeed *Max Schmidt*, who remains on that district's staff in an advisory capacity.

◆

C. W. Pearsall, manager of distributor sales of the Ahlberg Bearing Company, Chicago has been promoted to the position of general sales manager. Mr. Pearsall entered the employ of the Ahlberg organization in 1919 and since has served as a salesman in Chicago and Philadelphia, branch manager at Philadelphia and later at Chicago and then manager of distributor sales.

Eugene Roth has been appointed district sales manager of the Vascoloy-Ramet Corporation, with headquarters at the company's newly opened district sales engineering office at 50 Church st., New York.

◆

A. J. Erlacher, district sales manager for the J. G. Brill Company and the A. C. F. Motors Company in Pennsylvania, western Maryland, and southern New Jersey, has had his sales territory extended to include the states of North Carolina, South Carolina, Georgia, Alabama and Florida.

JOSEPH L. BISESI, former special research associate in engineering materials for the University of Illinois, has been appointed research and test engineer of

J. L. Bisesi

the Waugh Laboratories, a division of the Waugh Equipment Company. Mr. Bisesi was born on July 29, 1901, in New York City. Upon graduation in 1923 from the University of Illinois, where he received the degree of bachelor of science in railway electrical engineering, Mr. Bisesi was employed by the New York Central as a draftsman, in which capacity he assisted in conducting tests to determine locomotive service requirements at various points on the line. He also assisted in writing specifications for electric and oil-electric locomotives and cars and in making cost studies for electrification at various points on the New York Central System. In 1926 he was engaged by Illinois Central as an electrical inspector on cars for the electrification of the Chicago terminal. In 1927 Mr. Bisesi was in charge of inspection and tests of all electrical materials on the Chicago, Rock Island and Pacific. He also assisted in the inspection of other metallic and non-metallic materials. In 1931 he returned to the University of Illinois as special research assistant in engineering materials where, as a member of the staff of the Engineering Experiment Station, he was in charge of studies on non-destructive methods of detecting flaws in steel. This was part of a study of rails conducted under the auspices of the Association of American Railroads and the Technical Committee of Steel Manufacturers. In 1938 he was promoted by the university to special research associate in engineering materials. Mr. Bisesi received the degrees of electrical engineer in 1934 and master of science in electrical engineering in 1937.

◆

BALDWIN LOCOMOTIVE WORKS.—*Curtis G. Green,* formerly with the Chicago and St. Louis, Mo., district offices of the Baldwin Locomotive Works, has been appointed manager in charge of Diesel-locomotive sales with headquarters at Eddystone, Pa. *Arthur S. Goble,* for many years connected with various sales activities of this company, has been appointed assistant manager of the Chicago district office.

SIDNEY D. WILLIAMS, formerly vice-president in charge of steel sales for the Copperweld Steel Company, has been appointed executive vice-president in charge of the company's Warren, Ohio, division.

◆

JOHN W. CONVERSE, director of personnel training for the Baldwin Locomotive Works, has been elected a member of the board of directors and executive committee of the General Steel Castings Corporation of Eddystone, Pa.

◆

T. J. FLEMING, service engineer of Manning, Maxwell & Moore, Inc., has been appointed eastern representative of the Okadee Company and the Viloco Railway Equipment Company, Chicago, with headquarters at Chicago.

◆

COPPERWELD STEEL COMPANY.—*William J. McIlvane* has been appointed general manager of sales of the Copperweld division of the Copperweld Steel Company, succeeding *Robert J. Frank.* Mr. McIlvane was formerly eastern district manager and, later, sales promotion manager. Mr. Frank will continue as a vice-president and director of the company.

◆

SAFETY CAR HEATING & LIGHTING CO., INC.—*Pearce Whetstone,* sales representative of the Safety Car Heating & Lighting Co., Inc., at Philadelphia, Pa., has been transferred to the San Francisco, Cal., office where he will serve in a similar capacity. *Howard W. Keyser,* who has been in the electrical operation department, will succeed Mr. Whetstone as sales representative at Philadelphia.

◆

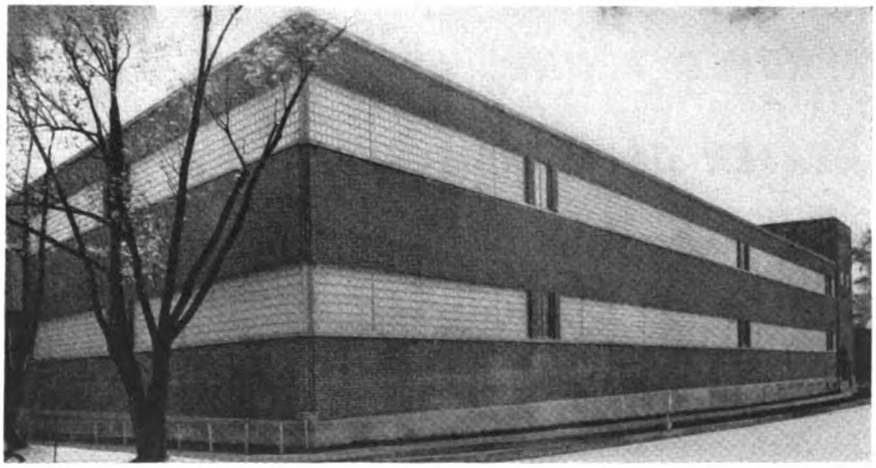
AMERICAN CAR AND FOUNDRY COMPANY.—*F. A. Stevenson* has been elected senior vice-president of the American Car & Foundry Co. He will continue in charge of operations as heretofore. *W. L. Stancliffe,* formerly manager of miscellaneous sales, has been elected vice-president in charge of miscellaneous and munitions sales.

Mr. Stevenson has served his entire business career with the American Car and Foundry Company. Beginning as an apprentice at its Detroit, Mich., plant he soon was transferred, as master mechanic, to the plant at Berwick, Pa. Later he returned to Detroit as assistant general manager, and upon the abolition of the office of general manager, became assistant to William C. Dickerman, now president of the American Locomotive Company, but then vice-president in charge of operations of the American Car and Foundry Company. During World War I Mr. Stevenson was in immediate charge of all of the

Frederick A. Stevenson

company's manufacturing operations at its plants at Detroit, Mich., and Buffalo and Depew, N. Y. Later he became first assistant vice-president and then vice-president in charge of operations, with headquarters at New York. In his capacity as senior vice-president, he is now responsible for the conduct of the company's large and varied manufacturing activities, not only as a builder of railroad equipment but also as a contributing factor in the program for preparedness in the national defense. Mr. Stevenson has been a member of the company's board of directors since 1929.

* * *



All finishing operations, after heat-treating, are concentrated in this recent addition to the plant of the Greenfield Tap & Die Corporation, Greenfield, Mass.—The addition more than quadruples the company's gage-manufacturing facilities

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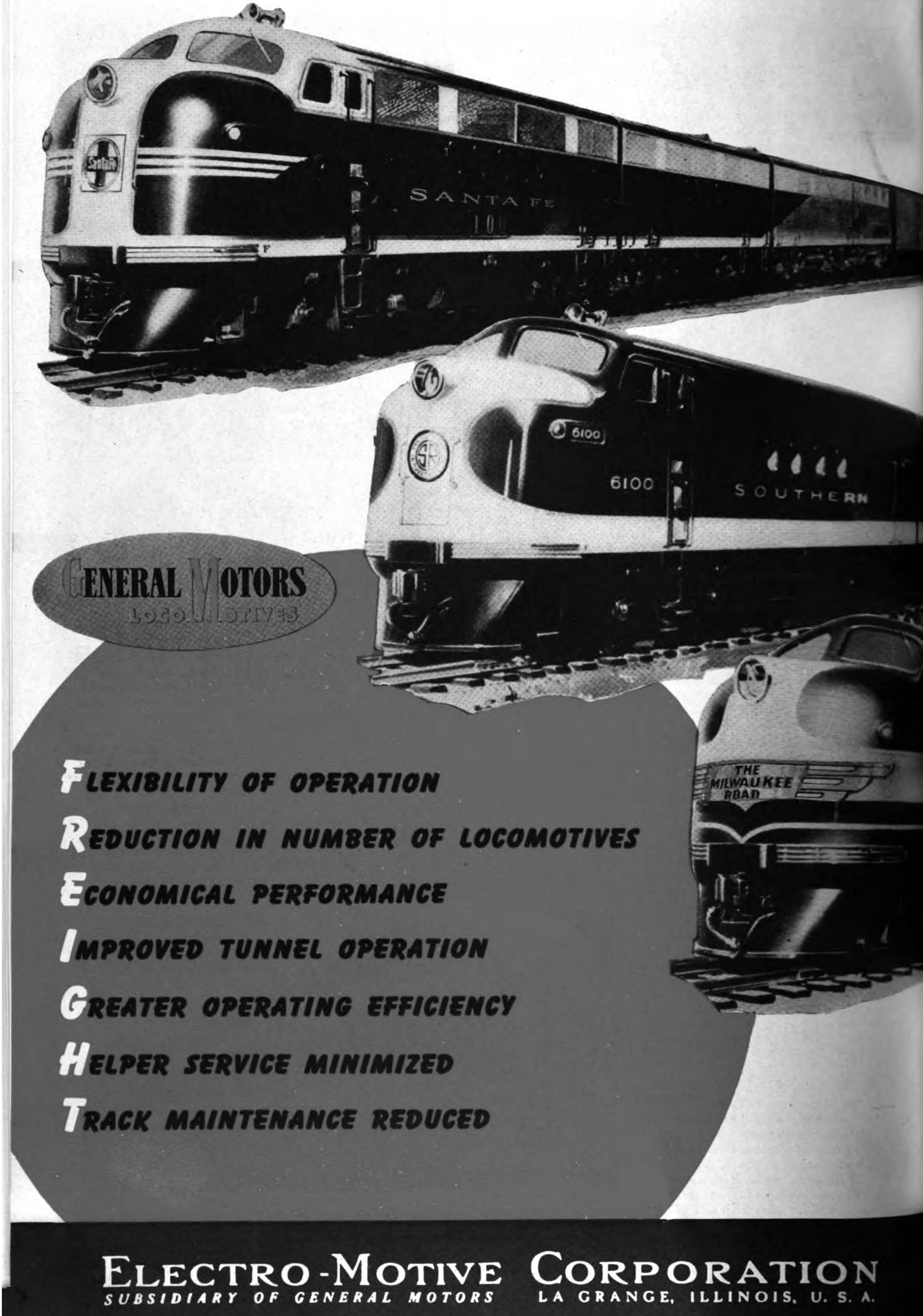

SANTA FE
Santa Fe
6100
6100
SOUTHERN
THE MILWAUKEE ROAD
GENERAL MOTORS LOCOMOTIVES
FLEXIBILITY OF OPERATION
REDUCTION IN NUMBER OF LOCOMOTIVES
ECONOMICAL PERFORMANCE
IMPROVED TUNNEL OPERATION
GREATER OPERATING EFFICIENCY
HELPER SERVICE MINIMIZED
TRACK MAINTENANCE REDUCED
ELECTRO-MOTIVE CORPORATION
SUBSIDIARY OF GENERAL MOTORS
LA GRANGE, ILLINOIS, U. S. A.

THE ST. LOUIS CAR COMPANY, St. Louis, Mo., is constructing three one-story brick and steel additions to its car-building plant. One building will be 232 ft. by 162 ft.; the second, 300 ft. by 240 ft., and the third, 80 ft. by 232 ft. in area.

◆

A. CHRISTIANSON has joined the staff of the O. C. Duryea Corporation as assistant to the president, with headquarters at Chicago. Mr. Christianson was formerly chief engineer of the Standard Steel Car Company and, recently, consulting engineer of the Pullman-Standard Car Manufacturing Company.

Obituary

GEORGE V. MARTIN, sales representative, southern territory, of the National Malleable & Steel Castings Co., died August 6 in an automobile accident. He was 67 years of age. Mr. Martin had been associated with the National Malleable & Steel Castings Company since 1904. Prior thereto he had been safety engineer with the Interstate Commerce Commission.

◆

EDWARD H. DICKINSON, assistant to the vice-president of sales of the American Locomotive Company, whose death July 9 was reported in the August issue of the *Railway Mechanical Engineer*, began his career in 1884 as a messenger boy in the freight office of the Lake Shore & Michigan (now New York Central). He was appointed billing clerk in 1887 and promoted to cashier in 1890. Mr. Dickinson

Edward H. Dickinson

left this railway in 1895 to enter the employ of the Brooks Locomotive Works at Dunkirk, N. Y., as assistant estimator, continuing in this capacity after that company was absorbed by the American Locomotive Company in 1901. In 1905 he was transferred to the New York office, where he served as chief clerk of the sales department until his appointment as assistant to the vice-president of sales. Mr. Dickinson was 71 years of age.

◆

JOEL S. COFFIN, JR., president and founder of the J. S. Coffin, Jr., Company of Englewood, N. J., died on August 8 of pneumonia at his summer home in Franconia, N. H. He was 50 years of age. Mr. Coffin was born in Waukesha, Wis. His father, the late Joel S. Coffin, Sr., before his death five years ago, was chairman of the board of the Franklin Railway Supply Company of New York. His brother, C. W. Floyd Coffin, is now vice-president of that company.

J. S. Coffin, Jr., graduated from Culver Military Academy and attended Stevens Institute of Technology. He entered the railway supply manufacturing business immediately thereafter and, in association with his father, organized the Franklin Railway Supply Company, Ltd., of Canada, in 1918. At the time of his death he was president of that company and had also recently formed the C.-S. Engineering Company of Englewood, a research organization for the development of railroad products. Mr. Coffin was a former director of the Lima Locomotive Works and the Franklin Railway Supply Company of New York.

Personal Mention

General

O. L. DEAN, shop superintendent of the Bangor & Aroostook at Derby, Me., has been appointed acting mechanical superintendent at this point.

RAY MCBRIAN, engineer of tests of the Denver & Rio Grande Western at Denver, Colo., has had his title changed to engineer of standards and research.

A. H. FIEDLER, general master mechanic of the Northern Pacific, Eastern district, St. Paul, Minn., has had his title changed to assistant superintendent of motive power.

A. B. CHILDS, mechanical engineer of the Northern Pacific, has been appointed chief mechanical engineer, with headquarters as before at St. Paul, Minn.

J. B. NEISH, mechanical superintendent of the Northern Pacific, has been appointed superintendent of motive power, with headquarters as before at St. Paul, Minn.

E. L. GRIMM, assistant to the vice-president, operating department, on the Northern Pacific, at St. Paul, Minn., has had his title changed to general mechanical superintendent.

R. J. MATTHEWS, mechanical assistant of the Northern Pacific at St. Paul, Minn., has been appointed assistant to the general mechanical assistant at St. Paul.

E. R. MANOR, general mechanical assistant of the Northern Pacific at St. Paul, Minn., has been appointed assistant general mechanical superintendent with headquarters at St. Paul.

C. D. LOVE, division master mechanic of the Louisville & Nashville with headquarters at Nashville, Tenn., has been promoted to superintendent of the Louisville division at Louisville, Ky., Mr. Love was born at Knoxville, Tenn., and attended the University of Cincinnati. He entered railway service in November, 1909, as a laborer in the mechanical department of the L. & N. at Knoxville, later becoming a machinist apprentice. After completing his apprenticeship at Knoxville at Etowah, Tenn., he served as a machinist at Etowah, later being transferred to Covington, Ky. In the spring of 1919 Mr. Love was promoted to the position of assistant enginehouse foreman and several months later was transferred to DeCoursey, Ky. On February 1, 1925, he became assistant master mechanic with jurisdiction over the shops at both DeCoursey and Covington and on June 15, 1931, master mechanic at Nashville.

E. J. KUHN, chief draftsman in the office of the chief mechanical officer of the Missouri-Kansas-Texas, has been appointed to the newly created position of mechanical engineer, with headquarters as before at Parsons, Kan.

HARRY E. HINDS, assistant mechanical engineer of the Chicago, Burlington & Quincy, has been appointed mechanical engineer, with headquarters as before at Chicago.

G. L. ERNSTROM, general master mechanic of the Northern Pacific, Western district, Seattle, Wash., has had his title changed to assistant superintendent of motive power.

H. W. RASOR, general foreman of the Air Line Junction (Ohio) enginehouse of the New York Central, has been appointed assistant to general superintendent of motive power, with headquarters at New York.

W. G. KNIGHT, mechanical superintendent of the Bangor & Aroostook at Derby, Me., who holds a commission as Colonel in the Officers Reserve Corps, United States Army, has been called to active service with his regiment, and assigned to duty in the First Corps Area at Boston, Mass.

L. W. Shirley, master mechanic of the Northwestern district of the Union Pacific at Portland, Ore., has been appointed to fill the newly created position of superintendent of motive power and machinery of the Northwest district, with headquarters at Albina (Portland), Ore. Mr. Shirley succeeds to a portion of the duties of L. L. Hoeffel, superintendent of motive power and machinery of the Western district, who continues as superintendent of motive power and machinery of the South-Central district, with headquarters as before at Pocatello, Idaho.

Samuel J. Hungerford, president of the Canadian National since 1932 and chairman of the board since 1936, has resigned the presidency of the system, including all subsidiary and affiliate companies. Mr. Hungerford was born near Bedford, Que.,

S. J. Hungerford

on July 16, 1872. At the age of 14 he began his career as a machinist apprentice in the shop of the South Eastern (now part of the C. P. R.) at Farnham, Que., in 1886. In 1891 he became journeyman machinist for the C. P. R. and worked at many points in Quebec, Ontario and Vermont. In 1894 he became chargeman at the Windsor Street station, Montreal. Beginning in 1897 a series of promotions through the mechanical department took him to jobs in many sections of the Dominion as follows: assistant foreman, Farnham, Que., 1897 to 1900; locomotive foreman, Megantic, Que., 1900 to 1901; general foreman, McAdam Junction, N. B., 1901; locomotive foreman, Cranbrook, B. C., 1901 to 1903; master mechanic, Western division, Calgary, Alta., 1903 to 1904. In 1904 Mr. Hungerford was appointed superintendent locomotive shops at Winnipeg, Man., and in 1908 became superintendent of the entire shop property at Winnipeg. In 1910 he started service with a constituent road of the present C. N. R., as superintendent of rolling stock of the Canadian Northern at Winnipeg. In 1915 he was transferred to the position of superintendent of rolling stock at Toronto, Ont. In 1917 he was promoted to general manager, Eastern lines, and upon grouping of the Canadian Northern, National Transcontinental and Canadian Government railways into the Canadian National in 1918 was appointed assistant vice-president (operating, maintenance and construction) of the new system. Two years later, in 1920, the Grand Trunk Pacific was brought into the amalgamation and Mr. Hungerford became vice-president in charge of these departments. In 1922 he became general manager of the system and in 1923 when the Canadian National had been made complete by the inclusion of the Grand Trunk he was appointed vice-president in charge of operation and construction. In 1932 Sir Henry Thornton resigned and Mr. Hungerford was appointed acting president. In 1934 this appointment was made permanent and in 1936 he assumed the additional duties of chairman of the board of directors.

Master Mechanics and Road Foremen

F. E. Molloy has been appointed master mechanic of the Southern Pacific, with headquarters at Bakersfield, Calif.

G. C. Bogart has been appointed assistant master mechanic of the Southern Pacific, with headquarters at West Oakland, Calif.

R. E. Harrison has been appointed assistant master mechanic of the Southern Pacific, with headquarters at West Oakland, Calif.

E. Woodruff, shop superintendent of the Pere Marquette at St. Thomas, Ont., has been appointed master mechanic with the same headquarters.

D. Beath, division master mechanic on the Canadian Pacific at Kenora, Ont., has been transferred to Winnipeg, Man.

J. B. Halliday, master mechanic of the Pere Marquette at St. Thomas, Ont., has been transferred to the position of master mechanic at Grand Rapids, Mich., to succeed W. G. Griffith, deceased.

Gregor Grant, locomotive foreman on the Canadian Pacific at Fort William, Ont., has been appointed division master mechanic with headquarters at Kenora, Ont.

F. C. Johnson, general locomotive foreman on the Canadian Pacific, has been appointed division master mechanic at Calgary, Alta.

J. D. Killian, assistant master mechanic of the Union Pacific at Portland, Ore., has been appointed master mechanic of the Oregon and Washington divisions, with headquarters at Albina, Ore.

Car Department

F. G. Moody, master car builder of the Northern Pacific at St. Paul, Minn., has been appointed superintendent of the car department, with headquarters at St. Paul.

Shop and Enginehouse

Albert F. Stiglmeier, general boiler department foreman of the New York Central at West Albany, N. Y., has been appointed general supervisor boilers and welding, with headquarters at New York. Mr. Stiglmeier was born in Buffalo, N. Y., on December 12, 1886. He received his education through the parochial school and the International Correspondence School. He became a boiler-maker apprentice on the Delaware, Lackawanna & Western at Buffalo, N. Y., in November, 1901. From 1905 to 1908 he was a journeyman boiler maker employed by the Tashenberger Bros. Co., the Howard Bros. Boiler Works, the Oldham Boiler Works, and the Barber Asphalt Paving Company, all of Buffalo; the New York Central at Depew, N. Y., and the D. L. & W. at Buffalo. In 1908 he became layerout and flanger on the D. L. & W. at Buffalo; in March, 1912, assistant boiler foreman on the Erie at Hornell, N. Y.; in July, 1912, general boiler department foreman on the Erie at Hornell; in November, 1912, assistant boiler department foreman in the locomotive shops of the New York Central at West Albany, and in 1917, general boiler department foreman at West Albany. From 1919 until 1923 he was employed as general boiler department foreman of the Baltimore & Ohio at the Mt. Clare (Md.) locomotive shops. He returned to the New York Central as general boiler department foreman at West Albany in November, 1923. Mr. Stiglmeier was chairman of

A. F. Stiglmeier

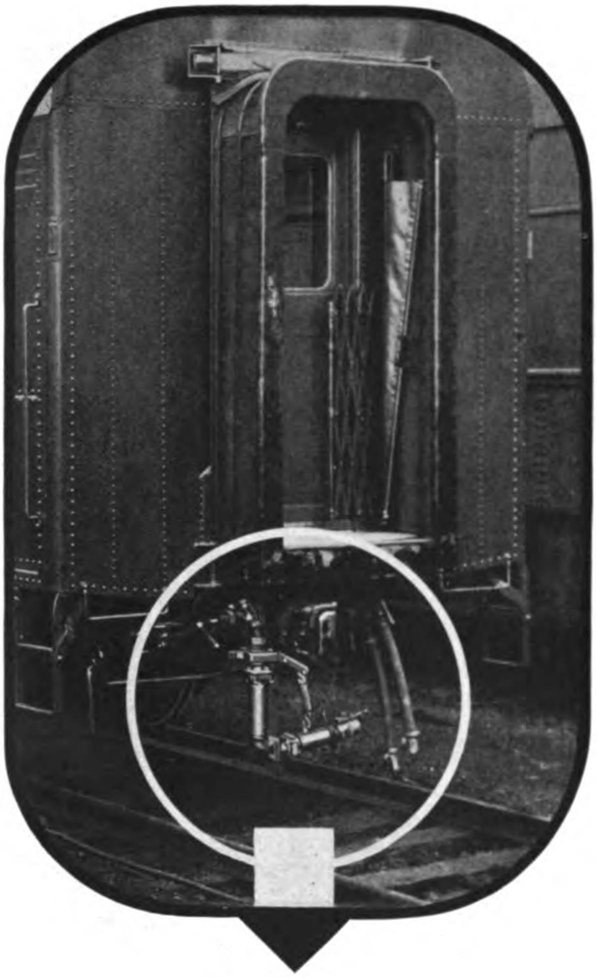
the executive board of the Master Boiler Makers' Association in 1926 and secretary in 1931. He has been secretary-treasurer of the association since 1936. He was president of the West Albany Locomotive Department Supervisors' Club in 1939 and is a member of the American Welding Society, of the Northern New York Section of which he was a member of the Executive Committee in 1939.

Obituary

L. A. North, a retired master mechanic of the Illinois Central died on July 30.

Thomas J. Wheatley, general foreman of the Chesapeake & Ohio at St. Albans, W. Va., died on June 28.

William G. Griffith, master mechanic of the Pere Marquette at Grand Rapids, Mich., died suddenly at his home in that city on June 24.



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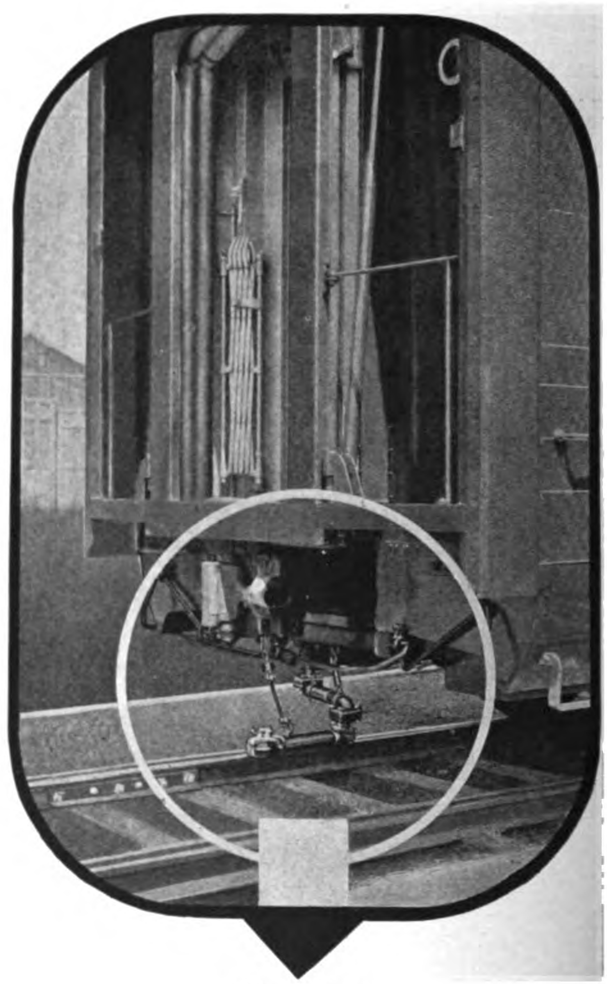

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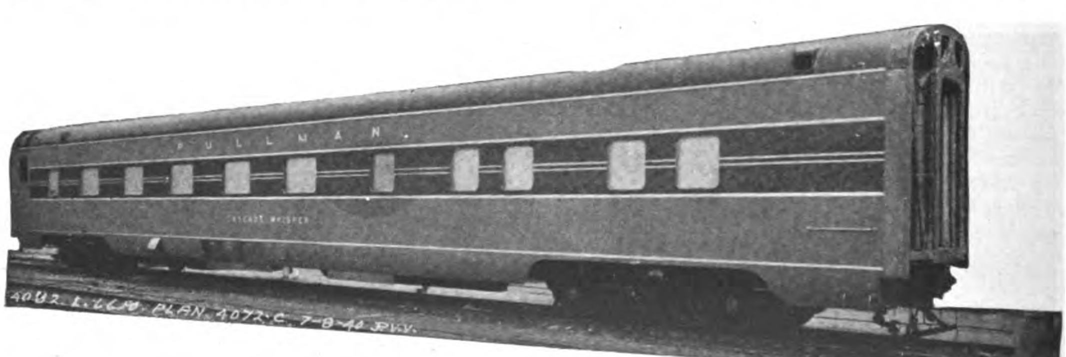

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October
1941

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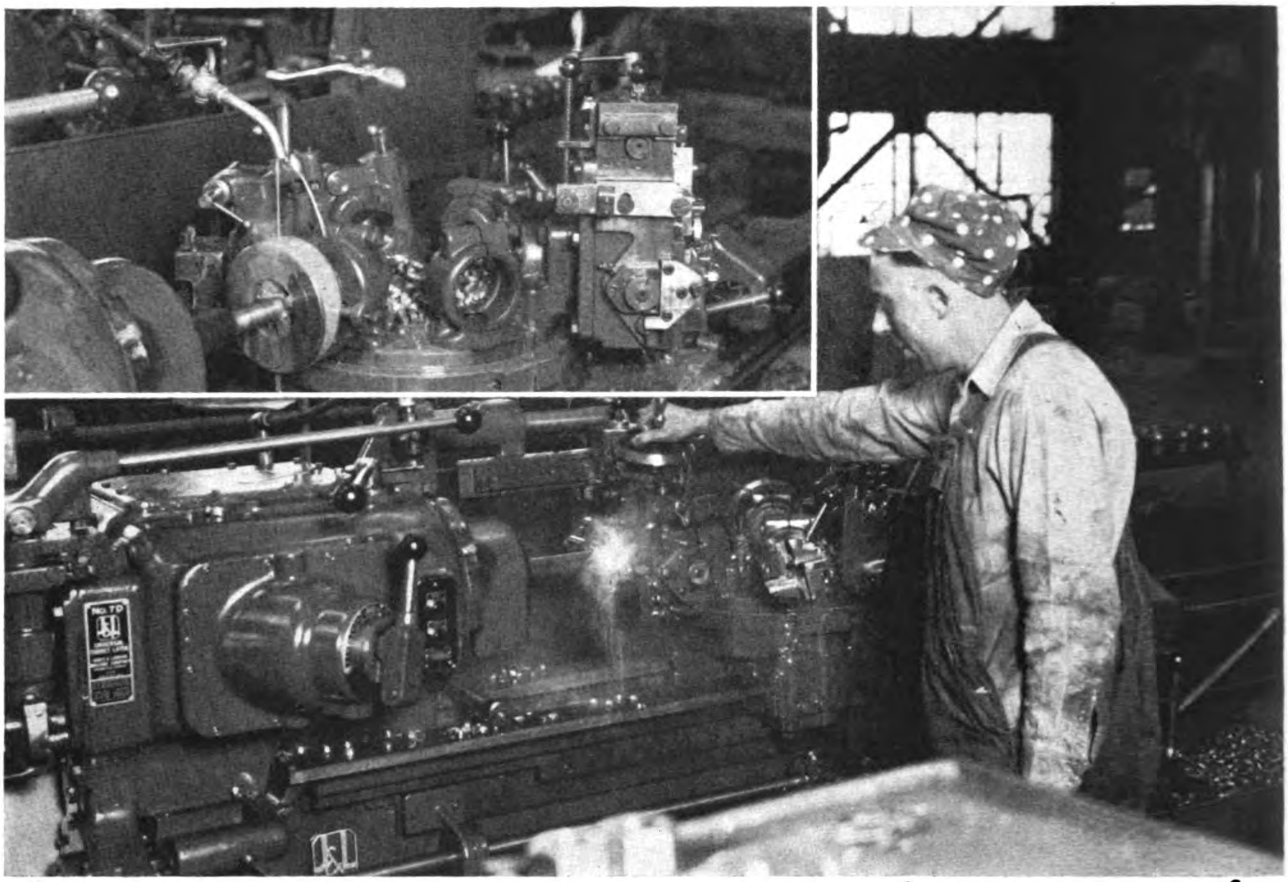


Announcement of Prize Competition

THE railroads of the United States and Canada, the backbone of our transportation system and specially adapted to the rapid handling of mass transportation, are a most vital factor in the national defense program. Undoubtedly they will receive more consideration as to priorities as time goes on, but at the very best they will be greatly handicapped for the want of materials, adequate facilities and equipment, and a sufficient supply of skilled labor.

In this emergency mechanical department officers and supervisors must exercise their ingenuities and abilities to the limit, to secure maximum results with what they have to work with, whether men, materials, facilities or equipment.

Never was it more important to pool the best ideas and experiences in order to insure that the railroads and transportation do not form a bottleneck in national defense production.

The *Railway Mechanical Engineer* is desirous of doing its full part in the present emergency. To that end a prize of $200 is offered for the best article submitted on or before January 15, 1942, on ways and means of improving the mechanical department's operations or practices to increase production and secure a larger use from the equipment and facilities. The writer of the second best article will be awarded a prize of $100. The decision of the judges who will be asked to pass upon these articles will be final. All other articles which may be accepted and published will be paid for at space rates. Entries in the contest should be addressed to The Editor, *Railway Mechanical Engineer,* 30 Church Street, New York, N. Y.

There are many ways in which the mechanical department can do its part in securing the best possible results from available facilities and equipment. Merely as suggestions, typical of the wide variety of possibilities, one might consider the question of improved designs, or the conservation of materials, or the selection of materials. It is conceivable that marked improvements might be made by the better marshaling and use of manpower. Improvements can and are being made, in many instances, in the effort to speed up the repairing of cars and locomotives and of the maintenance and servicing of locomotives at engine terminals. Shop production is being slowed up for the need of more up-to-date tools and facilities and the lack of the best types of cutting tools. What can be done to increase production in spite of these limitations and handicaps? These are merely suggestions and the winning articles may cover other phases of mechanical department operations, not specifically mentioned.

The award will be made on the basis of the practicability of the suggestions and the magnitude of the results to be achieved, so far as it is possible to ascertain or estimate them.

The statement was made in connection with the recent mechanical conventions at Chicago, that the mechanical departments of the railroads were "on the spot". The statement was also made that up to this time they have been doing an unusually effective job in keeping the equipment in first-class condition and available for service. The indications are that the transportation facilities of this country must be prepared to bear still heavier burdens in the days to come. The mechanical department faces, therefore, a very great and grave challenge. We know that the officers, supervisors and men in that department will meet this challenge and we hope this endeavor of ours to pool constructive ideas and suggestions as to how to meet the emergency, will be helpful in this effort.

• • •

Hawthorne Addresses Me

V. R. Hawthorne
Executive Vice-Chairman, Mechanical Division, A. A. R.

THE four groups of mechanical-department supervisors which constitute the so-called Coordinated Mechanical Associations held simultaneous annual meetings at the Hotel Sherman, Chicago, on September 23 and 24. These associations are the Railway Fuel and Traveling Engineers' Association, the Car Department Officers' Association, the Master Boiler Makers' Association, and the Locomotive Maintenance Officers' Association. There was no exhibit this year by the Allied Railway Supply Association.

The meetings began with a joint opening session over which Frank P. Roesch, vice-president, Standard Stoker Company, and chairman of the Committee of the Coordinated Associations, presided. The meeting was opened with impressive ceremonies which included the raising of the flags of the United States, Canada, and Mexico, and the singing of the national anthems of all three countries by Mary Jane Nicholson, daughter of J. M. Nicholson, mechanical superintendent, A. T. & S. F.

Address of Chairman Roesch

Mr. Roesch, in a brief address, emphasized the importance of full co-operation between the various departments of the railroads under present conditions. He spoke, in part, as follows:

"The National Defense Program will impose a heavy burden on the railroads, affecting all roads large and small to some extent, but under the present setup of the Association of American Railways and the resultant coordination of effort, there can be no question about their ability to meet the present situation or any future emergency that may arise. There are no pessimistic railroad men; on the contrary railroading is something like football: the greater the interference the harder they buck the line. You are the fellows that will have to take the brunt of it.

"We hear on all sides cries of possible power shortage, car shortage, men shortage and material shortage. Those who write these articles—often inspired by advocates of other-than-rail transportation—either know little of the resourcefulness of railroad men, or are not concerned about facts, so long as their stories make good reading and are accepted as fact by an unthinking public who echo the cry, 'the railroads are breaking down; we must build more concrete highways, pipe lines, ship canals or what-have-you to meet the needs of national defense.' If they would look for facts they would find that the railroads have never failed to meet any emergency in the past, and through coordinated effort are now stronger than ever.

"Let us look at the problem from an unbiased standpoint, not as a local problem, but as a national one, and we will get a true picture as to the comparative value of rail and other means of transportation. In support of that statement, we quote from an editorial in the September 15 issue of the Chicago Daily News: 'The American industrial machine is still in the main an organism that draws its lifeblood through railroad arteries. To formulate any industrial policy without taking thorough counsel of railroad men is going out of one's way to invite trouble. The railroads have plenty of competent men at Washington to help the defense effort. Let us hope that hereafter they are asked what they can do before we have any more shortages, curtailments, panics and useless recriminations.'

"As but for one example to illustrate the point: Shipyards are located on both seaboards. Smelters and steel mills are located well toward the center of the continent. Conceive if you can the number of trucks that would be required to haul the prefabricated plates, beams, etc., to the points of assembly if they could be so hauled at all. Water transportation is out of the question, as speed is the watchword. If all can get this picture as it really is, they can readily see that rail transportation is the keystone of the arch and if that were to fail, the whole defense structure would collapse with it. If these truths are accepted, it should be clear to those who are in position to hinder or to help that, if half the consideration were given to railroads that is given to other means of transport, there could be no fear of any interruption of the defense program.

"You men are the selected leaders in your various departments. It is on you as contact officers with the rank and file that much of the burden will fall. It will be up to you to make two blades of grass grow where but one grew before. Your deliberations will result in promoting new methods of doing old jobs.. Methods of conserving repair time in shops and terminals. Methods of obtaining more and better use from the material supplied. and through such methods increase the availability of power and equipment, and show the world that there is no such animal as a railroad man who is not equal to any occasion. If ever there was a time when railroad supervisory officers should get together and counsel with one another, that time is now."

Following his address Mr. Roesch introduced V. R.

chanical Associations

Four groups of mechanical department supervisors start successful two-day annual meetings with a joint session at which Frank Roesch presided

Hawthorne, executive vice-chairman, Mechanical Division, Association of American Railroads, who delivered the principal address of the joint session. At the close of Mr. Hawthorne's address the associations adjourned, each to reassemble in its own meeting room to take up its own program.

Mr. Hawthorne's Address

This meeting will, I am sure, be an inspiration and of great help to those who take part in the proceedings and discussions which have been so ably prepared. I wish to convey to you the greetings and best wishes of the officers and general committee of the Mechanical Division, Association of American Railroads.

As you are all aware, the American way of life has always been dominated by representative assemblies such as you have here. This goes all the way back to the town meetings of the early colonies in New England, through the period of the colonial assemblies and into modern times with the Congress of the United States and the multitude of societies, associations, etc., for the free discussion of all problems, political, economic, commercial, technical and practical.

Railway officers, some 75 to 80 years of age, when the interchange of freight between railroads first began, proceeded to organize themselves into groups and associations such as are meeting here this week. These associations provided a means whereby the officers of one railroad could meet the officers of other roads serving in a similar capacity and through reports and discussions exchange experiences and through the years improve the performance of all to the present state of efficiency. This progress has not stopped, but in a broad sense has passed from the elementary stage to the advanced stage where refinements and advanced technic are now the principal basis of discussion, report and endeavor.

In the early days of railroading in this country, railroad men with creative ability began to invent improvements in appliances and parts for locomotives and cars, which were patented. Companies were organized and plants developed for the manufacture of such appliances and parts, and there quickly developed an industrial group manufacturing parts and devices for sale to railroads. These manufacturers and builders of locomotives and cars in turn formed associations to consider and take action with respect to their common problems, particularly relating to the bringing of their products to the attention of the interested railroad officers.

Instructive Value of Exhibits

These groups of railway supply men have throughout the years arranged instructive and attractive exhibits of their products to coincide with meetings and conventions of railroad associations and have had no small part in the phenomenal development of our American railroad systems. Due to the stress of present conditions, no exhibit is being held with your meetings this year, but last year a splendid exhibit was held and was of great benefit to those in attendance. I hope that these instructive exhibits can be resumed after the present unsettled conditions have passed.

The science of railroading is always advancing. The application of scientific research to railroading has been an important factor in solving many problems. Among the large research projects of recent years may be mentioned the following: Air brake research program, extending from 1923 to 1933, resulting in the establishment of the present requirements for freight air brakes; air brake research progam of the last few years resulting in the establishment of the present brake equipment for high-speed passenger trains; axle research resulting in new designs of axle for passenger cars; truck research resulting in the development of a number of designs of trucks for high-speed freight service; research resulting in the development of improved materials for cars and locomotives such as: high-tensile steel plates, shapes, bars, etc., high-tensile steel castings, improved tires and wheels, improved forging materials, etc.; research in connection with roller bearing application to locomotives and passenger cars.

Much of this research has been a joint effort of the railroads and the manufacturers of materials which the railroads use. Very little of it has had any spectacular phases but has represented determined, conscientious and laborious effort on the part of both the manufacturers and the railroads.

A comprehensive series of road tests of locomotive counterbalance standards has just been started using instruments especially designed for this work. Laboratory tests will also be started in the near future to determine the causes for failures of main crank pins.

Continued Research Vital to Railway Progress

The continued research and study devoted to railroad problems and the application of new and improved methods, devices and materials as a result thereof has given to this continent the greatest system of rail transportation in the world. We have the most powerful and efficient locomotives. Our cars are of large capacity designed to fit the needs of our great industries, and, due to their rugged construction may be operated with but a small portion of their service life lost due to necessity of repairs. Our trains operate on fast schedules and carry more, so that their hourly output of transportation is double what it was 20 years ago. The fundamental wearing parts of cars have been so standardized that repairs may be made quickly from the material stock of any handling railroad regardless of the ownership of the car. Twenty years ago, freight car hot boxes on the road were approximately five times as frequent as they are now, per mile run, and engine failures were about seven times as frequent.

All of this past effort on the part of railroad men working largely through groups such as yours has brought about this record of accomplishment and has given us this great system of railroads which will play such an important part in the problems growing out of our present great national defense program. In other words, the railroads are doing their part in this emergency and have provided rail transportation adequate to meet present demands and will continue to do so.

The railroads however are still progressing. They will not stop progressing and call the job completed. The world in which we live is constantly changing and the railroads, in order to maintain their proper place in the nation's economic life, must not only keep pace with the needs of today, but must anticipate the needs of tomorrow and prepare to meet them.

Associations such as those meeting here at this time have had much to do with stimulating and directing thought to those problems that require intensive study. The information which you develop through your discussions and the recommendations which you transmit to the Association of American Railroads, I can assure you, will receive the most careful consideration. At this time any recommendation that leads to increased efficiency, improved equipment and maintenance or greater utilization of existing equipment should be thoroughly studied.

Car Officers Hold Succes

Two-day session at Chicago is devoted exclusively to a consideration of current pressing car problems

E. S. Smith,
Vice-President

F. E. Cheshire,
Vice-President

A. J. Krueger,
President

G. R. Andersen,
Vice-President

F. L. Kartheiser,
Sec.-Treas.

ıl Annual Meeting

A TOTAL of 334 members of the Car Department Officers' Association registered at the annual meeting held at the Hotel Sherman, Chicago, September 23 and 24. After the joint opening session of the co-ordinated mechanical associations, which was addressed by V. R. Hawthorne, executive secretary, Association of American Railroads, Mechanical Division, as described elsewhere in this issue, members of the Car Department Officers' Association re-assembled for the consideration of problems pertaining exclusively to car equipment and its efficient design, maintenance and use on American railways. The general character of individual addresses and committee reports was well up to standard and again, as was the case at the last annual meeting, the work of the association was officially commended by representatives of the A. A. R., Mechanical Division, as well as by railway mechanical officers of high rank.

The meeting was presided over by President A. J. Krueger, superintendent car department, N. Y. C. & St. L. In his presidential address, Mr. Krueger stressed the need of conserving car equipment by every possible means, expediting the repair of all classes of freight cars when found defective, and increasing the co-operation between mechanical and transportation departments, with a view to affecting smoother and more efficient operation, especially in train yards in so far as it effects inspection, air brake tests, switching, etc.

Individual speakers at the two-day meeting included E. B. Hall, chief mechanical officer, C. & N. W.; W. D. Beck, district manager, Car Service Division, A. A. R., and D. S. Ellis, chief mechanical officer, C. & O. Other speakers not on the scheduled program, who addressed the association briefly included K. F. Nystrom, mechanical assistant to chief operating officer, C. M. St. P. & P.; R. V. Wright, editor, *Railway Mechanical Engineer*, and T. J. O'Donnell, retired chief interchange inspector, Buffalo, N. Y., who was formerly an important factor in the association when it devoted itself exclusively to a consideration of problems of car interchange. During the course of the meeting, the association accepted reluctantly the resignation of Vice-President E. S. Smith, master car builder, Florida East Coast, who resigned, owing to the press of other duties and was elected a life member of the association.

Standing committee reports were presented on the following subjects: High-Speed Passenger Brake Equipment, Chairman J. E. Keegan, chief car inspector, Pennsylvania, Chicago; Shop Operation, Facilities and Tools, Chairman R. K. Betts, foreman car repairs, Pennsylvania, E. St. Louis, Ill.; Maintenance of Streamline Equipment, C. P. Nelson, general foreman, C. & N. W., Chicago; Lubricants and Lubrication, Chairman J. R. Brooks, supervisor lubrication and supplies, C. & O. Richmond, Va.; Freight Car Inspection and Preparation for Commodity Loading, Chairman A. T. Wagner, general car foreman, M. P., Dupo, Ill.; Loading Rules, Chairman H. T. DeVore, chief interchange inspector, Youngstown Car Inspection Association, Youngstown, Ohio; Interchange and Billing for Car Repairs, Chairman E. G. Bishop, general foreman car department, I. C., E. St. Louis, Ill.; and Assistant Chairman D. E. Bell, A. A. R. instructor, C. N. R., Winnipeg, Man., Canada. Abstracts of these reports will appear in this and subsequent issues of *Railway Mechanical Engineer*.

Cooperation Between Railroads and Departments

By E. B. Hall

Chief Mechanical Officer, C. & N. W. and St. P. M. & O.

In choosing the rather far-reaching topic "Co-operation," I was much influenced by the marvelous example of this we are witnessing today, resulting great monetary savings and highly satisfied shippers. The railroad men in this territory now, more than ever before, fully realize the seriousness of delaying freight, and the strenuous and unselfish efforts all departments involved are making to prevent it, is a shining example to prove that despite the keen competition existing between railroads, they can and do co-operate with one another.

Fully realizing that the car department is one of the most important factors in the transportation game, I feel that it should be given the best possible support by executive officers and other departments. The car men can, by fully understanding their many and varied regulations, and by the use of good judgment, save enormous sums of money, and while they are doing very well, I know that they can do better.

Time, however, will not permit detailing my reasons for making this statement, except to say that, special effort should be made to obtain better service from freight cars, which no doubt will become more important than ever before in connection with the tremendous task before us. The mileage can and must be increased, and the shopping of loaded cars in transit can and must be reduced. To accomplish this will, I repeat, require the best kind of co-operation between railroads and departments of railroads, and it seems to me that you could do

Officers Elected for Next Year

President: **F. E. Cheshire, assistant superintendent car department, Mo. Pac., St. Louis, Mo.;** ***first vice-president:*** **G. R. Anderson, district supervisor car maintenance, C. & N. W., Chicago;** ***second vice-president:*** **D. J. Sheehan, superintendent motive power, C. & E. I., Danville, Ill.;** ***third vice-president:*** **I. M. Peters, superintendent and secretary, Crystal Car Line, Chicago;** ***fourth vice-president:*** **P. J. Hogan, supervisor car inspection and maintenance, N. Y. N. H. & H., New Haven, Conn.,** ***secretary-treasurer:*** **F. L. Kartheiser, chief clerk-mechanical, C. B. & Q., Chicago.**

nothing better than to effectively deal with all such matters.

I have heard it said that your association would be of little value to the railroads, but I have contended that if properly conducted it can be very helpful, even though its activity is confined to bringing about better co-operative relationship, and a better understanding of how best to perform the duties assigned to you. Some may gain the impression that discussing your various classes of work repeatedly does not make for progress, but I deem that far more productive than to strive too much for new development, particularly so, when it becomes a matter of duplicating the work handled by the A. A. R.

In this connection may I say that the personnel of your various committees is tremendously important. The success and accomplishments of your association depends to a great extent on the earnest study and activity that these men so unselfishly devote to their particular assignment. . . . We often find men of high ability reluctant to act as chairmen of committees, largely for the reason that committee members cannot find time to attend meetings or assist by correspondence in the work of their committee, thereby placing a greater share of the work on the chairman. This situation, if continued, can only lead to a general breakdown of association activity, which in an association of this character and purpose would be exceedingly unfortunate.

I have arrived at the conclusion, which to some extent may be an admission on my part, that the remedy to this lies largely in the hands of chief mechanical officers. More car and locomotive department officers must be given permission to attend conventions of this character. Men selected for committee work must be given to understand that their supervisors encourage and support activity of this nature. That they be given full release from their railroad assignment to attend committee meetings, when called, is evidently very necessary. In other words, a more tolerant and co-operative spirit toward association work on the part of mechanical department heads is necessary. You may rest assured that I will do everything within my power to accomplish that result.

Present Car Conditions Requiring Attention

May I call to your attention a few matters which under present conditions appear to me to be of vast importance in the satisfactory movement of freight. In the prompt and proper classifying of freight equipment to secure full utilization of cars, the closest kind of co-operation with the Car Service Division is highly essential. Many miles of empty car haul can be avoided by intelligent inspection and commodity carding of cars at terminal points.

Avoiding the loading of bad order cars, particularly with defects of a nature that may result in transfer of lading at the first interchange point. There is still considerable to be accomplished in greater promptness in repairing loaded cars. Practically every commodity moving today calls for quick delivery to destination but regardless there are countless instances where cars marked out in terminals and particularly from noon or are held over some times as long as 24 hours, whereas with proper facilities and full co-operation from your operating departments, the cars in most cases could have departed on schedule.

Perhaps never in the history of the railroads were there as many loads of different character and size moving on open-top cars as there are at present and, therefore, it is exceedingly important that extreme care be exercised in seeing to it, first, that these loads are loaded strictly in accordance with A. A. R. loading rules, and second, that they be carefully inspected at all terminals enroute to determine that they have not been disarranged. Naturally it is likewise important that the equipment furnished for such loading is not defective, in order that the lading be properly secured.

I have been much impressed with your temperate method of functioning since you re-organized under the jurisdiction of the Association of American Railroads, and I feel confident that your future efforts will create improved team work and prove highly beneficial to your employers.

Conserving Railway Equipment

By W. D. Beck

District Manager, Car Service Division, A. A. R.

War and war prospects are uppermost in the minds of every one and taxes are probably next. I am making a guess that the third apprehension is the question of prompt and safe transportation of materials whether these be for National Defense or for consumption at the breakfast table.

United States railways have been "on the spot" for a good many years; they were lambasted hither and yon for car shortages up until about 1922, but since that time there have been no shortages of equipment, nor of transportation requirements. As a matter of fact, they are moving the present business with a smoothness and regularity never before equalled.

Two reasons account for this: (1) The rehabilitation of the properties at an expense of some eight or ten billions of dollars following the return from government control, and (2) the organization of Shippers Advisory Boards, of which more anon.

In naming these two reasons, I am not unmindful of the very great part that your organization occupies in the field of transportation. To you is given the responsibility of designing the equipment which must be acquired. To you comes the additional responsibility of seeing that, once obtained, it must be kept in perfect repair and this matter of perfect repair these days means much more than just having a box on wheels as was once the case.

Today shippers and receivers of freight require a car which will carry the most fragile and the most elusive of materials from one end of this country to the other without damage. You know this and you know too that the average person would be amazed if he were told what we had to do to and for a car, flat, box, or otherwise, before it could be accepted to carry most any kind of a shipment.

But enough of that because it is your job and mine, and of course we conform. Let us not forget, however, that the present increased loading and consequent plus in our revenues, is not going to cure the steam railroad financial situation because of the many inroads thereupon, with more to come.

The railroads today own about 1,660,000 cars. They have put into service since January 1, 1941, 49,000 cars. They have on order 92,000 cars and others will be purchased early for 1942 and 1943, the number of which, of course, will depend upon the priority orders for the necessary materials. The average carrying capacity of all these cars is better than 50 tons each.

The bad order situation, 4.8 per cent, not only for light but for heavy repairs is the best in the history of man and reflects the ability of your organization (plus, we ought to say, a little more easily-opened pocket book). Thus, we are geared up to loading 900,000 cars and better, per week and it is not requiring any great effort to maintain that altitude day after day. I am satisfied we can go to 980,000, or may be a million by continuing a constant alertness.

Strangely enough, our net ton miles are almost even with what they were in our bounteous years of 1926 to 1930. A surprising thing, due of course, to two things; (1) the increased speed of freight trains, and (2) the larger carrying capacity of our freight cars. As to these two items, the car and locomotive departments deserve much credit.

Incidentally, every freight car owned by United States Railroads in 1941 performed three-fifths more transportation service than in 1918.

The Function of the Car Service Division

May I put in just a word or two about the Car Service division and their especial responsibility in seeing that car service rules are observed. This is not an idle gesture, but is intended to bring about a condition which you as maintenance men fully

appreciate, you want your own cars home so that they may be in proper repair.

We try to bring that about, (1) because the owners are entitled to the use of their cars, and (2) because we know that expert maintenance of equipment will result, and (3), because long experience has taught us that car service rules observance brings about an adequate car supply.

I said we would consider the Shipper's Advisory Boards later. These are great organizations, there being 13 of them in the United States, their respective areas conforming to the Car Service division districts. They were formed, as you know, to co-operate with the railroads in matters having to do with transportation. Not since their formation have we had a car shortage. We do not expect one and will not have one so long as these shippers do what they are doing for us today, i. e., releasing cars within free time, loading cars to capacity, ordering cars only as needed, loading cars without delay and loading them in accordance with car service rules wherever it is practical.

This is not just idle talk—these men are doing exactly what I've said and are crying for more opportunities to help. They have, indeed, organized Vigilance committees all over the United States to see that every shipper does his part in the prompt release of loaded cars in the complete unloading of cars so that with dunnage, bracing and other paraphernalia removed, it is ready for the next shipper without going to the cleaning track.

These committees will watch every phase of the freight car game. There have been 70 or 80 set up in this Mid-West Shippers Board area of Illinois, Iowa, Wisconsin, Upper Michigan and Western Indiana. They know, you know and I know that with so many misguided people seemingly hungering for government control of the railroads we just cannot slip once. We all know that with shippers, receivers and railroad organizations, such as yours, working and pulling together, as to any transportation burden placed on the railroads, whether it be a million, or a million and a half cars a week, we will get away with it.

I would be amiss in failing to mention the very considerable loading not only now extant at ordnance plants and other government institutions, but that which is in prospect. Such places as Savanna, Elwood, Kingsbury in Illinois, and many such places elsewhere, will soon be in full production, and all will require the highest grade of car. We shall have our work cut out for us there and then.

Let me say this for the real government agencies. In this great defense program which they are engineering, the railroads are receiving their most skillful help in the matter of heavier loading, in the non-delay to empty cars awaiting loading and (more than anything else) in the prompt release of equipment.

Many of us remember what happened during the last war when 200,000 cars loaded with government freight were delayed (some of them for months) awaiting release from load.

Absolutely nothing of this sort is occurring today; in other words, government authorities are co-operating a thousand per cent.

Better Maintenance of Freight Cars

By D. S. Ellis

Chief Mechanical Officer, Chesapeake & Ohio, Cleveland, Ohio

The ultimate goal in the maintenance of freight car equipment should, as with locomotives, be sought on the basis of maximum economy to the railroad consistent with demand and expeditious movement of commodity to destination, which means a minimum of interruptions in the continuity of such service. To realize this attainment to the extent possible, of course, involves many contributing factors which must be co-ordinated by the supervision in all departments in order to produce the desired results.

It is necessary that all employees know what is required of them, and this leads to the advisability or necessity of preparing and issuing complete standard instructions to all concerned, including shop supervision, and that all be required to understand such instructions and perform their work in accordance therewith. Properly prepared instructions should be a valuable guide to the workmen and especially effective in promoting standardization in repairs to equipment. I cannot lay too much stress at this time on the necessity of carefully policing and following up to see that these instructions, when issued, are properly adhered to and followed, for the success or failure of improved maintenance depends on how carefully the job is policed.

Train yard repairs, such as putting in journal bearings, brake hangers, and pins, tightening loose running boards, box bolts, safety appliances, etc., if handled satisfactorily, become an appreciable item of economy in addition to preventing delays in car movement. It is of great importance that all materials and tools be properly distributed in repair yards, readily accessible to the repair men, in the interest of conserving the time of said repair men. Consideration should also be given to the proper location of clothes lockers, drinking water, and the many other numerous items and facilities required, in order that they be located to the best and most economical advantage possible.

Empty foreign cars known to be enroute home, if in safe condition to move to home line, and barring safety defects, should not be shopped. Such practice if adopted by all lines, would eventually lead to each road repairing its own cars, and such practice is also in accordance with Rule 1 of the Code of Rules for the Interchange of Cars.

Records prove that the average car is on the light repair track several times a year. The ideal situation would obtain if cars could be given necessary repairs at the time they are shopped for repacking journal boxes to keep them running until the next repacking—a period of approximately 14 months. This may seem too long but it is not impossible of attainment except insofar as failures occur which are completely beyond our control, such as defective wheels, damaged safety appliances, worn out brake heads, etc., but with improved maintenance even such failures should decrease in frequency.

The possibilities for increasing the time between shopping of cars is at once obvious to all of you car department men when it is realized that each of you can, no doubt, recall many instances of seeing cars on the repair tracks within a week or two of the time they were previously on repair tracks shopped for repairs that you know should have been made at the first shopping. Examples may be cited, such as decayed running boards, defective wheels (for one purpose or another), worn-out brake heads, low couplers, etc. These examples, to my mind, are the result of carelessness on the part of repair track supervisors. We have known instances on our lines, of cars being on various repair tracks three and four times in as many days and for repairs that should have been made at the original shopping.

It is very significant to consider what may be accomplished by interested co-operation and co-ordination on the part of the operating department. We have dwelt on some of the essential items on repairs to equipment. To prevent damage to equipment through rough handling and thereby effect much economy is well within the scope of possibilities. It is a familiar sight to see cars kicked in switching, with such speeds as are certain to result in damage to equipment and lading. Damage due to such impacts are very costly to repair since the car structure is frequently damaged, center sills broken, ends bulged out, draft gear stops broken, etc., all of which involve labor and material for repairs, and a break in the continuity of service. Renewal of broken couplers and draft gears on such damaged cars is frequently required, and car parts too numerous to mention fail under certain conditions of high speed car impact.

Much has been said of damaged car equipment due to the carelessness on the part of train crews, but relatively little accomplished. Co-operation, therefore, between the operating and mechanical departments to improve this situation is not only timely, but necessary. May I suggest here that your organization make this a subject for consideration jointly with

the Operating department. Improvements will depend upon the interest created. The Operating department can help by keeping cars fit by proper handling.

Co-operation between repair track, shops and designers of equipment, and our engineers, should be encouraged since suggestions from the men themselves who make the repairs to equipment often result in designs which are more easily repaired, lower in initial cost, and most economically maintained. In writing specifications for new equipment little or no thought may be given to the practicability of removing or replacing a part unless contact is had with the men doing such work in the field who are in a position to know where difficulty is experienced. In fact, it is being more and more appreciated today that the need exists for suggestions from men in the field, and many suggestions for improvements have accordingly been included in new designs. This feature in design should be uppermost in mind with the thought, of course, that strength must always be safeguarded, and ease of removal and replacement must be accomplished but not at the cost of weakening the freight-car structure.

Lubricants and Lubrication

Careful and extensive checks have been made of journal box packing as found in journal boxes of many cars from various ownerships, and the following are some of the conditions found:

A. A. R. Rule 66 is not being complied with in the packing of boxes, in that many boxes have been found to be not only overpacked but improperly set up. It is again emphasized that this matter should be called to the attention of the officers not only of the railroads, but also the private car companies who are responsible for this practice.

Many cars have been checked and the condition of the packing noted, and from this observation there is only one conclusion possible, which is, many companies are doing a very poor job of reclamation as packing in boxes of some cars with new packing dates has been found to be dirty, gritty and a large per cent of packing with short ends, etc., in fact on some cars with new packing dates the condition of the packing indicate the only thing new about the job was the markings showing repack point and date, and in order to correct this condition, it is recommended that consideration be given to suggesting to the A. A. R. that the A. A. R. inspectors in Division V, Mechanical be required to obtain a sample of reclaimed, saturated packing from each point inspected and such samples be sent to a designated laboratory for analysis, and when samples are found that do not comply with the A. A. R. requirements the A. A. R. so advise all member lines and the offending company be prohibited from billing for packing of journal boxes as set up in A. A. R. Rule 66. This step we believe is necessary and will go a long way towards correcting inferior methods of reclaiming journal box packing.

Hollow Back and Corrugated Back Journal Wedges

In the examination of many hot journals this type wedge is being found, some in very bad wornout condition. It is very evident that these wedges are not being closely inspected at the time of periodical repacking.

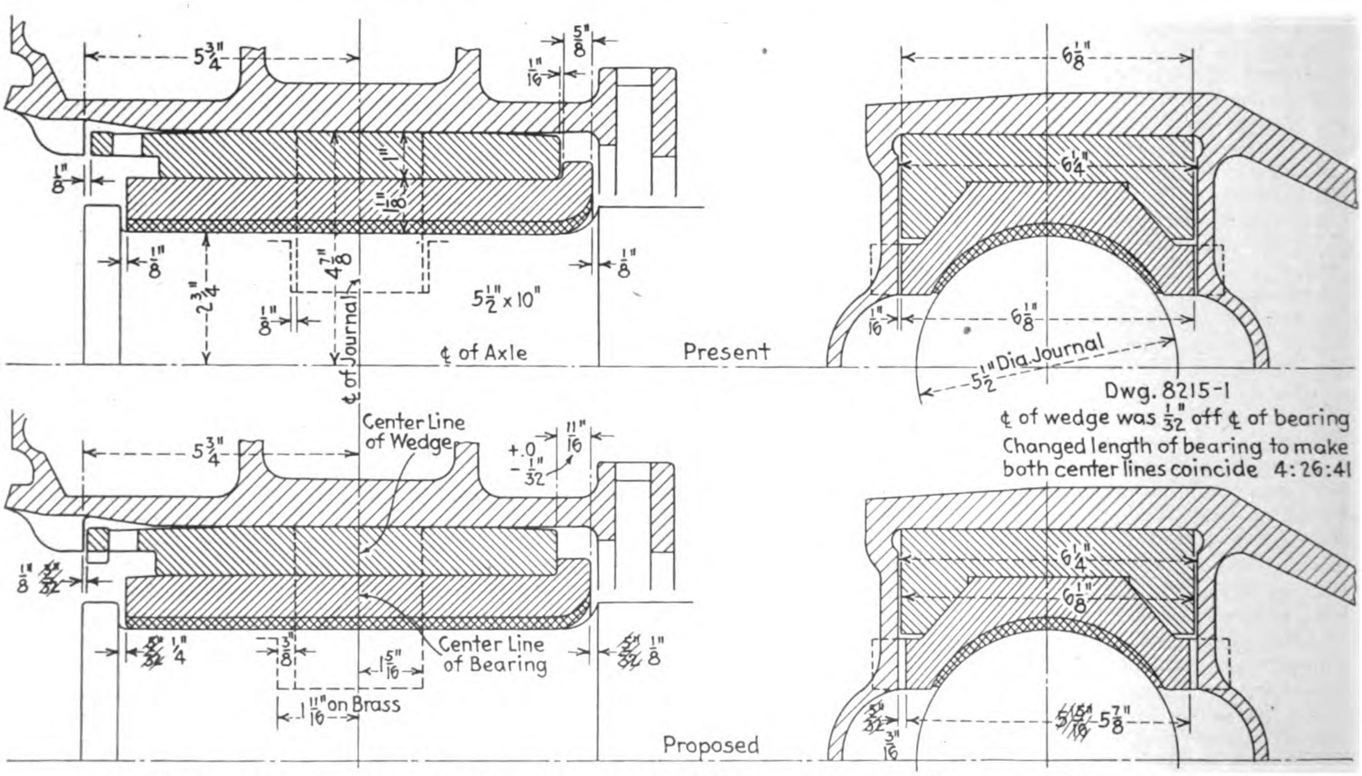
Your committee is of the opinion that these wedges should be closely inspected and removed from service as soon as possible and replaced with the journal bearing wedge conforming to the A. A. R. specifications.

Refrigerator-Car Drains and Drip Pans

Considerable trouble has been experienced with hot journals due to the improper maintenance and design of drain and drip pans on such cars. The drain and drip pans either rust out or get out of place, allowing the water to drain directly on top of the journal box, and in many cases directly into the journal box, particularly when box lids are not properly maintained or missing. This water in sufficient quantity will wash out the oil, which will effect the proper lubrication of the journal and cause trouble. It is our recommendation that this matter be called to the attention of the refrigerator car owners for correction.

Proposed Changes in Present Standard Bearings

Following up last year's recommendation regarding the necessity of changes in the dimensions of the present standard bearings. The question of the complete box assembly has been given



Alterations in present journal bearing and wedge proposed at Chicago meeting of the Car Department Officers' Association

considerable thought and this feature was considered by your committee with the following conclusions:

(a) That regardless of dimensions present or proposed all such dimensions and tolerances as set up by the A. A. R. be held to by all manufacturers, and when wedges, side frames (boxes) or bearings are being offered by any manufacturer that do not come within the prescribed tolerances, such units be rejected.

(b) That all such units be used in equipment which will be offered for interchange must be inspected, and the use of such units not coming within the prescribed tolerances be prohibited in equipment which will be offered for interchange.

(c) All wedges must be finished square on ends and sides so that square contact will be made.

(d) The attached drawing No. 8215* shows the action of the present standard bearing and wedge.

(e) Drawing 8215-A* shows the changes for the brass and wedge as recommended by your Committee.

(f) Drawing No. 8215-1 shows the present and proposed wedge, brass and box, and it will be noted that the brass is tapered on the end in order to allow free movement of the wedge on the brass at the collar end of journal.

You will note we have used the 5½-in. by 10-in. assembly on Drawing 8215-1. Changes in all other size bearings, wedges and boxes should be in similar proportions.

* Not included in the present abstract of the committee's report.

Your committee feels that with the proposed changes; i.e., closer inspection of all materials to assure compliance with limitations as set up, properly prepared packing—new or reclaimed, good workmanship in packing and setting up boxes—a much better hot box performance will be made by all concerned.

The report was presented by Chairman J. R. Brooks, supervisor of lubrication and supplies, C. & O., Richmond, Va.

Discussion

The discussion of this report brought out that the general purpose, in recommending changes in overall dimensions of the journal brass and wedge assembly and the application of a taper to the outer end of the brass, is to assure a design which will put all of the lateral thrust on the wedge and thus prevent undue wear, slipping or spreading of the brass lining with attendant hot boxes and train delays.

F. E. Cheshire, assistant superintendent car department, M. P., said that the tolerances now permitted render the wedge ineffective in resisting forces at right angle to the axis of the journal, and that the recommendations in this report constitute one of the most constructive things this association has ever done.

(The report was accepted and recommendations ordered referred to the A. A. R., Mechanical Division.)

Freight Car Inspection for Commodity Loading

The committee, realizing that our time is limited this year, has endeavored to sum up their discussion of and reaction to the assigned subjects as briefly as possible without omitting reference to some of the more important subject matter. After analysis of reports previously submitted, and the discussion pertinent thereto, we felt that a majority of the members of this association favored the adoption of a uniform commodity card, to be used in connection with a uniform set of general instructions to cover the selection and inspection of cars for loading various commodities. We believe that the adoption of a uniform card will be of advantage to all railroads, but appreciate that inauguration of its use will not immediately correct all of the errors in judgment in classification of equipment by inspectors and others. This feature must be policed locally and if properly done then we feel that eventually the use of the uniform card will eliminate duplicate inspection and reclassification. Only by such policing by local car department supervisors and strict adherence to the uniform instructions, can this be accomplished. The card itself cannot do it.

In an effort to emphasize to those here today, the large number, various sizes and kinds of commodity cards now in use, we have prepared and set up before you, an exhibit showing samples of cards submitted from many roads. It should be obvious from this that a uniform card is needed, also that the card shown in Circular T-25, issued under date of December 17, 1937, met with some favor, as you will notice several of the roads have patterned their cards after it. This card has been referred to many times before in reports and discussions; it is uniform card that was recommended by the A. A. R.

Several samples of proposed cards were received by the committee, who, after careful consideration, selected the one, illustrated, to be submitted for your approval. Its merits will undoubtedly be threshed out here, following presentation of this report. Also to facilitate handling to a conclusion here, we have had some samples printed for distribution among you. We shall not attempt to cover all of the details in this report, believing that these can be brought out better by discussion. However, a list of the commodities coming under the letter symbols, as drawn up by the committee, is included in that portion of the report covering uniform commodity requirements.

Class A Car

For high-class freight, such as cereals, coffee (non-roasted), copra, doors (glazed), flour—flax, grain products in paper carton and sacked, meal, paper (news print, etc.), paper cartons, phosphate, sacked food products, salt, sugar, sulphate, starch, soda ash, tin cans, tin plates.

1.—After classifying, this car will be loaded and forwarded to a destination probably hundreds of miles from your point. Before applying commodity cards, examine the trucks, wheels, running gear and car body with a view of bad ordering any car which has defects that might cause it to become bad order enroute, in preference to using it for loading.

2.—Car must be clean and free from contamination such as odors, oil, grease, dust, poisons and other residue from previous loads on interior of car and must not have:

(a) Protruding nails, screws, bolts, or loose, rough or broken lining, floor, etc., slivers, patches, or any sharp or rough edges or projections such as may penetrate or tear the sacks by contact.

If interior shows water stains (indicating leakage), examination shall be made to determine the defect has been corrected.

(b) Leaky roof, or roof sheets loose or shifted.

(c) Sheathing loose, leaky or with crevices, holes or any other defects that may let rain or snow into the car.

(d) Leaky doors, or otherwise defective, not fitting closely at top, bottom or sides of the opening, such as may permit leakage of rain or snow into the car, door fixtures (including locks, hasps, etc.), defective or missing, door stops (front), bent or broken, if preventing proper closing and locking of door.

(e) Broken or loose door posts, or side or end posts broken or out of place.

Car must be weather-proof at sides, ends, roof, and doorways, (this to be determined by getting inside the car, closing doors and observing whether daylight penetrates at any point).

Class B Car

For freight such as: Beans (bulk), black sheet, cement, carbide, explosives, excelsior, fertilizer in bags, etc., tobacco, grain and feed (bulk), glass bond, matches, malt products in paper cartons, ore, plaster, steel—finished plate, stucco.

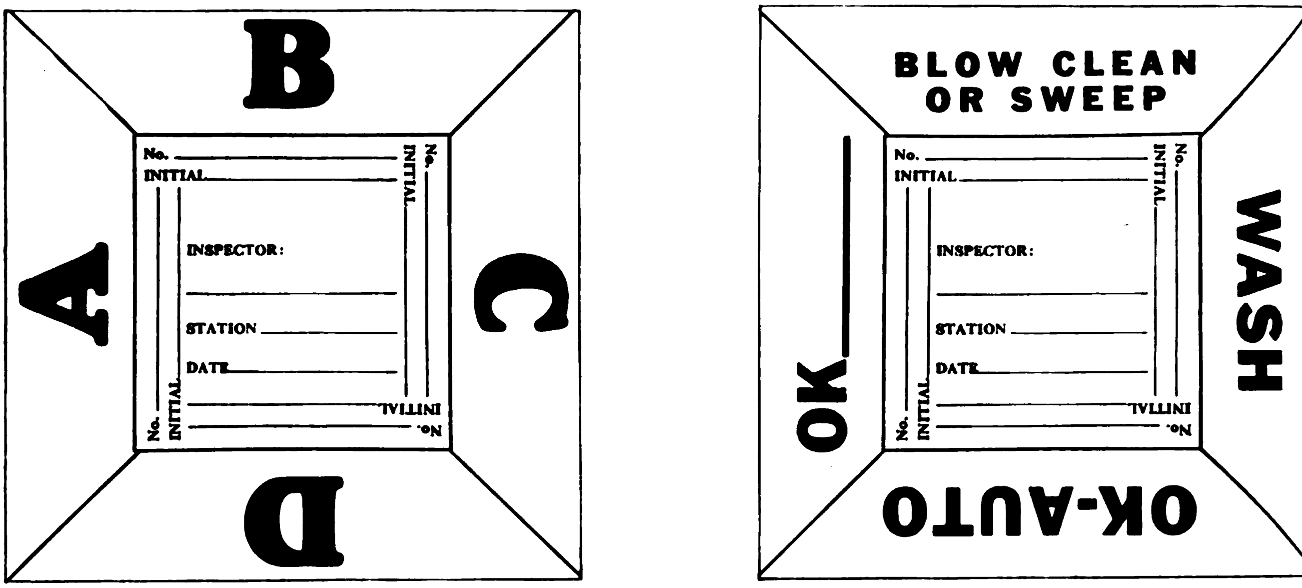
1.—Same as for Class A car.

2.—Car must be clean and free from contamination such as odors, oil, grease, dust, poisons and other residue from previous loads on interior of car and must not have:

(a) Floor broken or with holes or crevices, or loose fitting, as may permit leakage of grain, ore, etc. Protruding bolts, blocking or floor patches, etc., that may interfere with the use of unloading scoop.

(b) Lining, missing or broken. Where beveled grain strips are standard to car they must be intact and properly fitted to prevent leakage.

(c) Posts, braces or other parts of superstructure broken, decayed or loose fitting.



Front and back of commodity card which the C.D.O.A. recommends for adoption as standard by the A.A.R., Mechanical Division

(d) Roof leaky, or roof sheets loose or shifted.

(e) Sheathing—open, decayed, holes in same, loose, broken or any other defects that will permit leakage.

(f) Doors broken or defective to the extent rain or snow can enter car. Door fixtures (including locks, hasps, etc.), defective or missing. Door stops (front) bent or broken, if preventing proper closing and locking of doors.

Car must be weather-proof at sides, ends, roof and doorways. This to be determined by getting inside of car, closing doors and observing whether daylight penetrates at any point.

Class C Car

For freight generally recognized as merchandise, such as agricultural implements, auto parts, cotton, charcoal, candy, canned goods, dry goods, furniture, graphite, hardware materials, roofing, radiators, refrigerators, sulphur, tanks, tubs, wire (woven), etc.

1.—Same as for Class A car.

2.—Car must be clean and free from contamination such as odors, fresh oil and grease spots (dry spots without odor will not warrant rejection), coal and cement dust or other residue from previous loads on interior of car and must not have:

(a) Protruding nails, blocking, etc., that may cause damage to lading.

(b) Leaky roof, sides or ends that will permit damage to lading.

(c) Missing or defective doors and door fixtures that will prevent proper protection to lading and closing of doors.

Class D Car

For freight generally recognized as Rough Freight, such as acids, bolts, car wheels (loose), castings, drums, hides, lumber (rough), pig iron, pulp, rough mill freight, spikes, slag, tar, ties, wire, etc.

1.—Same as for Class A car.

2.—Car should be reasonably clean but does not need to meet the requirements of a Class A, B or C car, and must not have:

(a) Protruding nails, blocking, etc., which may cause damage to the lading.

(b) Floors that are not in serviceable condition.

(c) Doors and door fixtures, that are defective or missing, or doors that cannot be properly closed and locked.

Automobile Car

Equipment furnished for loading of automobiles must have good tight sheathing and roofs to prevent leakage of rain or snow into the car.

Car must be clean and free from contamination such as odors, dust, poisons and other residue from previous loads; also protruding nails, bolts and old blocking.

Flooring must be in good condition in order to properly secure automobile.

Cars equipped with auto racks, "auto loaders," must have such equipment properly maintained and same should be carefully inspected and tested before cars are applied on order. These racks should be raised into position next to roof of car and properly secured when cars are empty.

Your committee realizes that all commodities are not listed in the uniform commodity requirements set forth here, our intention being to list only those necessary to help identify the different classifications. Your attention is also called to the fact that on the sample uniform card submitted, provisions are made for writing or stamping any special commodities the various roads might wish handled in this manner.

We would recommend that paper of such specification as will stand the elements be used, also that in application of cards sufficient tacks be used to prevent slipping or loss of card, using a minimum of three in each one.

Your attention is also called to the fact that some roads use commodity cards on open top cars, samples of same being included among those shown in our exhibit. This committee feels that the uniform commodity card presented to you can be used for this purpose by using the symbol *A* for sand, gravel, powdered coal, etc.; symbol *B* for lumber, steel, pipe and similar commodities and additional symbols as might be required, this of course to be at the discretion of the individual roads.

Discussion also brought out that several roads seal or wire the doors of empty cars at the time of classification to prevent contamination or damage to equipment before cars are placed for loading and it would be our recommendation that this be brought to the attention of the freight claim division for such handling as they deem necessary.

The uniform commodity card and uniform commodity requirements set forth here are hereby submitted to you for approval and submission to the Association of American Railroads for adoption.

The Contaminated Car

Deviating somewhat from the assigned subjects, but in line with many requests received your committee felt that a part of this report should be devoted to the contaminated car. An effort was made to frame something to place the responsibility with the offending road; but after much discussion in a joint meeting held with Committee No. 7 (Interchange & Billing for Car Repairs), it was agreed that the fundamentals for perfecting an arrangement must necessarily be inaugurated by the transportation people. Suggestion was made that waybills of cars loaded with contaminating commodities be stamped by the agent at loading points to show such contamination and that the responsibility for having such cars cleaned before being reloaded be placed with the agent at the unloading point. If and when

such a plan is put into effect whereby we of the mechanical department will be in a position to definitely know the line originating cars loaded with contaminating products such as those shown in Circular Letter of the Chairman, Car Service Department, A. A. R., dated October 27, 1930, then we believe that appropriate additions to the A. A. R. Interchange Rules can be recommended with the thought of placing the responsibility with the loading line for the cost of reconditioning such cars, where such reconditioning involves repairs to the car to restore it to its former classification.

This committee is still of the opinion, however, that a joint meeting between representatives of this organization, the Freight Claim Division and the American Association of Railroad Supervisors will be necessary before such additions to the interchange rules can be formulated and made effective.

The report was presented by Chairman H. E. Wagner, general car foreman, Missouri Pacific, Dupo, Ill.

Discussion

G. R. Andersen, district supervisor car maintenance, C. & N. W., said that the commodity card recommended in the committee's report is a definite step in the right direction, but raised a question regarding the size of the printing.

Joe Marshall, special representative, A. A. R., Freight Claim division, said that he was much interested in the committee's report because of the possibility of reducing freight claim payments by adoption of some of the committee's recommendations. Mr. Marshall said that freight damage is caused not alone by defective cars, but by contaminated cars, and mentioned several instances of damages, in one of which five cars of wheat, previously loaded with soda ash not completely cleaned from behind the lining, were moved to an elevator and unloaded in a bin which already contained 11 carloads. The entire bin of grain was contaminated by the soda ash and a damage claim of $22,500 was paid. In another instance, a car loaded with arsenic was subsequently used for the transportation of oats which were fed to horses and killed nine of them. Mr. Marshall thought it would be a fine idea to mark the waybills of cars loaded with contaminating commodities and hold the unloading point responsible for cleaning.

C. J. Nelson, superintendent, Chicago Car Interchange Bureau, made six motions, which were seconded and adopted as follows: (1) That the report be accepted; (2) that the proposed commodity card be submitted to the A. A. R., Mechanical Division, for possible adoption as standard practice; (3) that if and when approved by the A. A. R., the use of this card be made mandatory after a reasonable time to exhaust the supply of cards on hand; (4) that, if approved, the A. A. R. include specifications covering the kind of paper and printing; (5) that the present exhibit be turned over to the Mechanical Division for educational and display purposes; (6) that the association express its appreciation to the committee headed by Chairman Wagner and also to the chief mechanical officer of the Missouri Pacific, without whose co-operation this valuable report could not have been prepared.

Interchange and Billing for Car Repairs

At the outset we wish to make it clear that this is truly a Committee report, that while we have had but one opportunity of meeting, which meeting was held at St. Louis, June 17 and 18, and at which every member of the committee was present, we have corresponded throughout the year, every committee member promptly passing his opinion on the many questions submitted.

Many cases have been considered, the subject matter of which does not appear herein. Each has been given careful consideration and, for the purpose of brevity, only those that, in our opinion, justified recommended rule changes are included.

Rule 4, Par. (d).—Revise completely to read: "Other house cars.—When more than four boards of sheathing are split or broken, or when raked into tongue." (No change in Notes.)

Reason: A study develops that passage of cars through large interchange points is being seriously hampered as a result of car inspectors consuming time to thoroughly inspect cars for protection for minor delivering line defects. The need for more rapid movement is apparent. Study further develops that in the majority of cases involving such minor damage the repairs are not made until cars pass through shops on regular shopping schedule. There is, therefore, no reason why such minor damage should not be absorbed as deterioration the same as other owners' conditions existing on the car.

Rule 4, Sec. (g), Par. (3).—Revise completely to read: "Defect cards shall not be required for the following damage when not directly associated with other delivering line defects: (a) Push pole pockets—all cars; (b) Side door fixtures attached to door of car body—House cars."

Reason: Revision in this rule is desirable to provide the car owner be responsible for damage to side door fixtures when not directly associated with other delivering line damage, as these items can be, and often are, damaged in fair usage. The need for this change to eliminate unjustified defect carding against delivering line has been brought to the attention of this committee many times during the past few years, and a similar recommendation was made last year. The urgent necessity for action on this recommendation is again stressed.

Rule 19.—Eliminate last two items. Add a new item reading: "Wheels condemnable as per Rules 82 and 83."

Reason: Present rule prohibits application of certain condemned cast iron wheels, such as those which have been condemned for out-of-round and reclaimed by grinding. It is felt that this rule should also prohibit application of wheels condemned by remount limits.

Rule 32, Sec. (b).—Eliminate the phrase reading: "Or failure to properly control moving cars with car retarding device." Eliminate the first Note.

Reason: Cars damaged on a manual hump are handling line's responsibility only when damaged to the extent of Rule 44, in accordance with the provisions of Section (d) of Rule 32, and it is felt that the same protection should be extended to lines having retarder equipped humps. When car has minor damage such as a broken coupler after handling on a retarder device hump, the circumstances must be investigated to determine that there was no failure to properly handle car with retarding device. Progressive lines are thereby penalized for facility improvement. Actual study discloses that there is less equipment damaged on a retarder equipped hump than on a manual hump.

A. A. R. Billing Rules

Rule 9.—Add a new paragraph to read: "When brake beams, spring planks, wheels or truck bolsters are R&R or R, repair card must show whether or not truck is equipped with bottom rod or brake beam safety supports of any type, and (if so equipped) whether or not such supports were R&R or R."

Add additional item to Section "Brake beams R&R." to read: "Whether or not equipped with removable chair casting and (if so equipped) whether such castings were R&R or R."

Reason: To facilitate reference and coincide with Rule 17 Int. (B-5) and (B-8).

Rule 17, Int. (C-2).—Eliminate portion of second paragraph of answer reading as follows: "Except such non-AAR standard cast steel yoke and key and coupler body, if not defective, shall be held and promptly reported to car owner for disposition. If car owner elects to have such yoke and key and body returned, shipping instructions must be furnished within thirty days, and freight charges collect; otherwise such yoke and key and body may be treated as scrap."

Reason: Experience has shown that owners very rarely request return of this material, and as it is not AAR standard, and of no use to the repairing line, it is not felt that the cars and handling, as now required by this interpretation is justified.

Rule 87 (a).—Add additional item to the third sentence wherein is listed items for which counter bill is prohibited if not corrected within nine months from date of first receipt of car on home

* It should be clearly understood that the recommendations made in this report are intended for submission to the A. A. R., Mechanical Division, and are in no way authoritative or effective until duly considered and favorably acted on by that body.

line, or on any line within twelve months, from date of repairs: "Brake levers."

Reason: Claim for improper repairs are being made more than one year after application, and it is felt that if the brake levers are not replaced within one year, owner has received good value for repairs made and no claim is justified.

Rule 101.—Delete Item 52. Delete the words "or convertible type" from Item 54-A. Add the words "or non-convertible type" to Item 56.

Reason: Item 57-T of Rule 101 specifies that credit per Item 54-B of Rule 101 is to be allowed for convertible or non-convertible type triple valves regardless of the condition of the body. Item 57-F, 57-G, 57-K and 57-L of Rule 101 show that the valve of convertible or non-convertible type triple valve applied is the same as the value of either of these types removed. There is consequently no need for separate prices to be quoted in Rule 101 for the bodies of such valves, as shown in present Items 52 and 54-A. The revision of Item 56 of Rule 101 is recommended to render this Item consistent with Items 57-K, 57-L and 57-M of Rule 101.

Rule 107 (Item 166).—In the first note to this item clarify: "Sill splices on ordinary steel underframe cars."

Reason: There is confliction of opinion as to whether this phrase intends that arbitrary labor allowances shown in Items 168, 169, 195 and 200 will apply to splicing steel sills or whether it applies to splicing wood sills only on cars which are equipped with both wood underframe and steel underframe. The allowances in these items do not cover the cost of splicing metal sills equitably.

Rule 111.—Delete Item 6.

Reason: Already covered by Item 114 of Rule 107.

The sub-committee on billing for car repairs was assigned the special task of submitting recommendations for the improvement of the Index to the A. A. R. Interchange Rules, and interim report is attached hereto. The recommended revision is confined almost entirely to adding additional rule numbers to existing items in the Index where such rules appear pertinent to such items. The addition of a section covering coupler yokes under the heading "Yokes" is a recommended form in which it is believed that the Index would cover individual parts of cars more advantageously than is the case at present. If this form is approved by the A. A. R. the committee hopes to be in a position to present a completely revised Index next year.

The sub-committee was also requested to prepare a recodification of Rule 98. Our report this year is confined to recommendations for the deletion of certain items in this rule and the transfer of one item to another rule. Substantial work has been done in connection with setting this rule up in a form which would correlate matters pertinent to each other more advantageously, however, as the work has not progressed to the point that a complete report can be made at this time, the subject is being continued on the docket and it is expected that a recoded rule can be submitted at the next convention.

While meeting at St. Louis, a joint meeting was held with Committee No. 6, Freight Car Inspection and Preparation for Commodity Loading, for the purpose of discussing and placing of responsibility for damage to cars as the result of being loaded with contaminating commodities.

It was agreed that the fundamentals for perfecting a suitable arrangement must necessarily be inaugurated by the transportation department; it being our thought that way-bills of cars loaded with contaminating commodities should be stamped by the agent at loading point and the responsibility for having car cleaned should be placed with the agent at unloading point.

If, and when, some such plan is placed in effect whereby we of the mechanical department will be in a position to know what cars have been loaded with contaminating commodities and where they have been loaded, we will recommend appropriate additions to the A. A. R. Interchange Rules with the thought of placing responsibility for the cost of reconditioning high class cars, restoring them to their former loading classification, at the expense of the loading line.

Numerous instances have been brought to our attention wherein extensive damage has been caused by unloading machines coming in contact with the interior of cars, and the responsibility for such damage was not assumed by the handling line as intended by Interpretation (4) of Rule 32.

While this committee recommends no change in this interpretation, it does recommend that railroads on whose property such damage occurs assume full responsibility for such damage and attach their defect card to the car as per Rule 4, Par. (a), and failing to do so, they be more consistent in conducting investigations to determine whether or not such damage occurred while cars were in their account, when later presented with joint statements, assuming the expense of repairs, if after an honest investigation the damage unquestionably occurred on their line.

Repairing lines are being called upon in numerous cases to reimburse car owner on the basis of intermediate line's billing repair cards in connection with improper brake beams where, for example, the original repairing line indicated a No. 15 beam applied whereas the intermediate line reports a No. 2 plus beam removed. In many of these cases it was developed that the original repairing line had no stock of No. 2 plus beams, and consequently could not have applied the improper beam as claimed. It is, therefore, felt that sufficient care is not being taken in reporting correct information to show the type and location of brake beams applied and removed. This committee, therefore, requests all to take more care in proper compilation of billing repair cards to the end that this condition may be eliminated.

We wish to bring before this association the need for minimizing defect carding, lessening the time now required for car inspectors to inspect cars, particularly at the larger interchange points. This, of course, will have to be accomplished through the reclassification of defects, assessing the car owner with many defects that are now the responsibility of the delivering line under the interchange rules, and with the thought that some definite action can be taken in this regard at the next convention, we urge the members, railroad and private line alike, to write us making suggestions as to what, in their opinion, should be done.

That part of the committee report pertaining to car interchange rules was presented by Chairman E. G. Bishop, general foreman, car department, Illinois Central, Centralia, Ill., and the section on Billing by Assistant Chairman D. E. Bell, A. A. R. instructor, Canadian National, Winnipeg, Man., Canada.

(The report was accepted practically without discussion.)

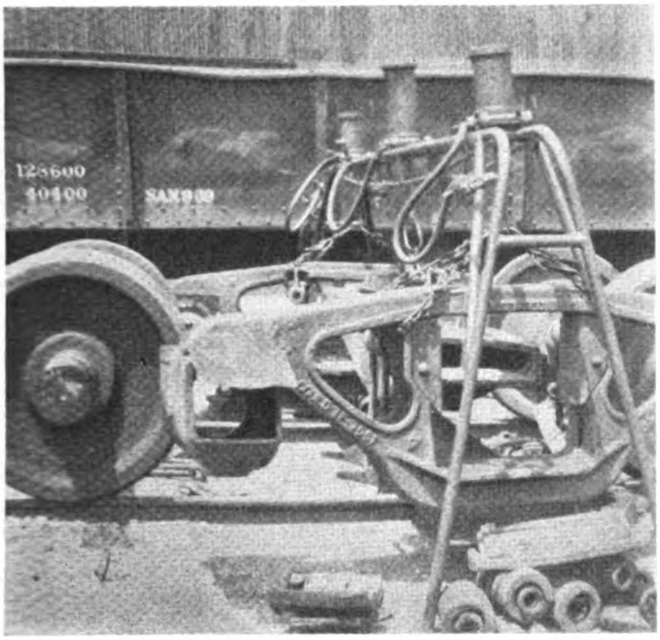
Shop Operation, Facilities and Tools

As the subject indicates, we shall endeavor to bring to you a description of various car shop devices which may be adaptable in many of your car shops, with a brief explanation of their operation.

It is a recognized fact that the membership of our organization is thoroughly familiar with the use and value of standard manufactured car shop equipment and we will make no attempt to discuss it here as it is well advertised to all concerned. Therefore, our report will be confined to home-made devices which have been designed and built to meet the particular requirements and to solve the problems of individual car shops on the various railroads.

Through the years, this subject has been much talked and written about in a piecemeal fashion, but, insofar as we are able to develop, no concerted effort has ever been made to consolidate ideas and information in regard to home-made car shop devices and make them available to all. Therefore, the Car Department Officers' Association will be the first to bring this matter to the fore in a definite report with the thought in mind that the membership will reap the benefits. When we take into consideration the multitude of car shops which are scattered all over the United States, Canada and Mexico, we begin to realize the scope and possibilities of this study.

Both large and small shops have developed numerous devices to speed up production, reduce personal injury hazards, and, last but not least by any means, to extend the efficient working life



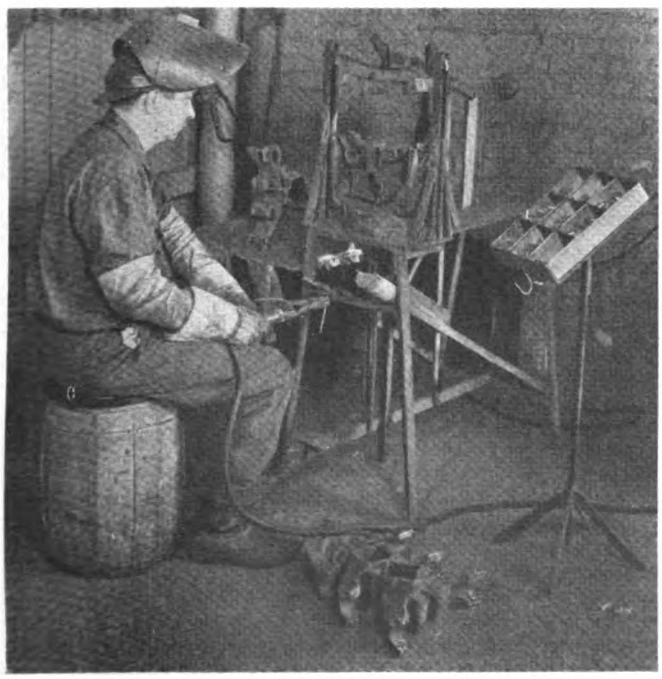
Group 1 (A)—Portable truck repair hoist

of the trained employee. With the slow turn-over of labor in recent years, the ability to obtain experienced new men has presented a serious problem. Adequate shop facilities have helped considerably to handle the work under these adverse conditions. With the present emergency, brought about by nation-wide defense preparations, car shop forces will be pressed to the limit to keep car equipment in condition for constant service. It is readily apparent that the better and more complete our facilities are, the easier will be the task.

In conjunction with our report, we have procured photographs of several units which will be reproduced in the annual minutes. It will be appreciated that photographs or drawings of all the devices hereinafter described, would require excessive space and we have endeavored to select those which are best illustrated in this manner.

Group 1—Truck Repairs Hoists

Hoists designed to facilitate repairs to unit type freight car trucks.



Group 2 (A)—Brake beam head welding jig

(A) Portable hoist which consists of a framework constructed of angles, pipe or T-sections or combinations of all three. This unit sets over the truck to be dismantled and can be equipped with light chain hoists, square thread turnbuckles or air cylinders to raise and lower the truck side frames and bolsters. The illustration shows a hoist equipped with air cylinders. This is a new idea and two distinct advantages are claimed for it, i.e., the maximum speed of operation and, due to cylinders being mounted on top of frame, it is lower and better balanced for movement from one location to another; (B) Permanent truck hoist, single or double—jib type, (see Fig. 7 Page 31, January, 1940, *Railway Mechanical Engineer*) for installation where cars are moved to established Spot positions for truck repairs. This type of hoist requires a good foundation, preferably of concrete, for the vertical post. The frame of jib swings to a parallel position with the track when not in use. The same type of equipment is used for raising and lowering truck sides and bolsters as with the portable unit; (C) Permanent truck hoist, collapsible type, for Spot position installation (See Fig. 6, Page 30, January, 1940, *Railway Mechanical Engineer*). This unit is equipped with a counterweight at one end and, when not in use, may be raised to a vertical position requiring a minimum of space. Other equipment is the same as on the two units previously described.

Group 2 (B)—Brake head grinding machine

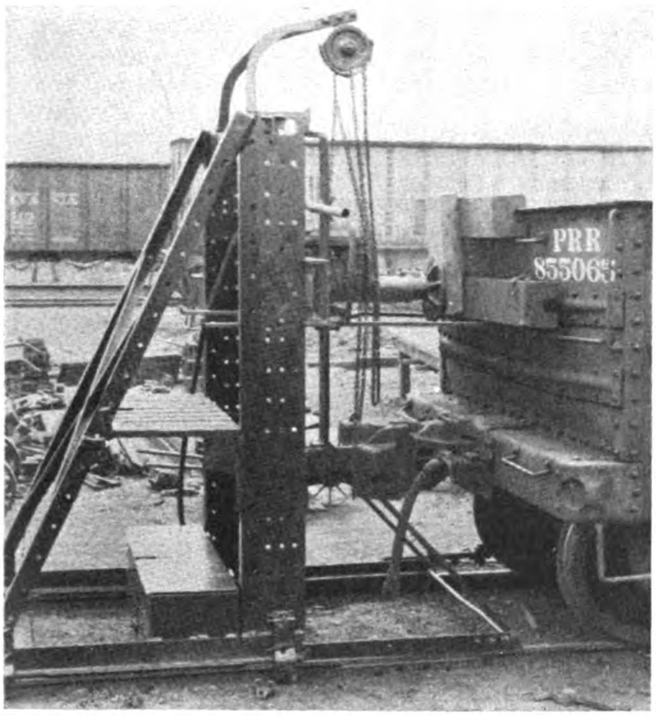
Many car shops have been equipped with truck hoists for some time and the use of these devices alone have made it possible to cut the time in half; or even less, on wheel renewals and other truck repairs. Furthermore, their use has practically eliminated damage to journals which previously resulted in connection with the removal and application of truck side frames when trucks were dismantled for repairs.

Group 2—Brake Beam Head Reclamation Jigs

(A) The welding jig. This unit is used to hold the brake head in firm position while checking for wear and building up by welding to restore the original dimensions. It will be noted from the illustration that the machine is equipped with a foot pedal which is used to bring the upper portion of the jig down on the brake head for gaging after which small metal shims are tack welded on the work surfaces to reduce the amount of welding material necessary to apply. The welding is completed after the

brake head is removed from the jig; (B) The brake head grinding jig. After the brake head has been built up by welding, it is placed in this machine and ground to the proper radius for the brake shoe fit. The grinder is air operated and the brake head is held rigid while grinding with the foot pedal as shown in the illustration.

Brake beam heads are an important factor in the repair cost



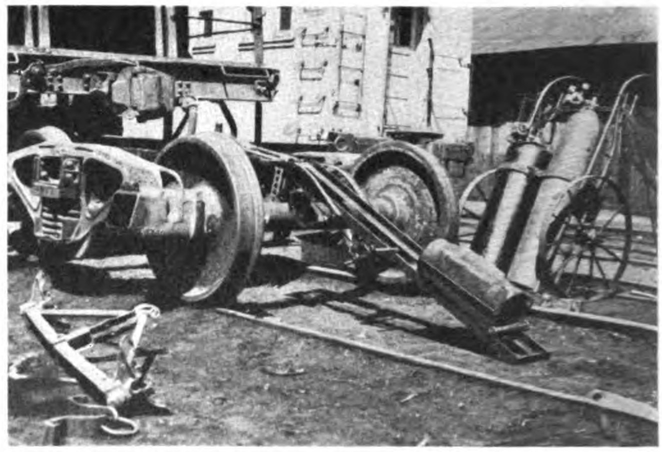
Group 3 (B)—Device for straightening freight car ends

of reclaimed brake beams. Tests have developed that they can be built up by welding successfully if proper care is exercised in the selection of welding rods and he welding machine amperage is accurately regulated for this type of work. It has been stated that the reclamation if brake heads by welding costs approximately one half as much as the purchase price of new brake heads.

Group 3—Miscellaneous Devices

(A) Journal box packing mixer (See Page 371, September, 1941, *Railway Mechanical Engineer*). The operation of this unit can best be described by comparing it to a concrete mixer, except that the revolving speed of the drum is much slower. The drum is about five feet in diameter and has an opening at either end, one to put the packing into and the other to remove it from after

Group 3 (C) All-purpose light-repair-track truck

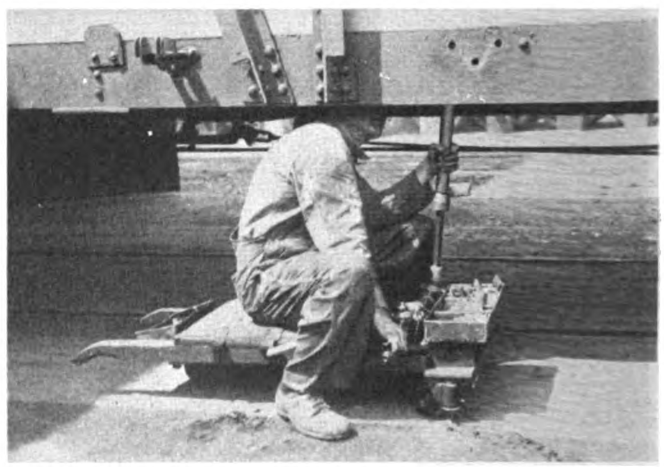


Group 3 (D)—Device for applying draft gears

mixing. The turning of the drum is accomplished with a three horsepower electric motor mounted on top of the framework which has a sprocket chain drive to the drum. The illustration is self explanatory in regard to the construction.

The saturation of journal box packing is an important factor in obtaining proper lubrication of freight car journals. It is claimed that this device keeps the packing evenly and thoroughly mixed until it is ready for application to the journal box. It eliminates the necessity of pumping oil over the packing at frequent intervals. In fact, the packing is taken from the shipping containers and placed directly into the mixer as required for daily use. This saves considerable time and labor in handling.

(B) Device for straightening ends of freight cars. This unit is built up of angles, channels, a ½-ton chain hoist, an air jack, a straight shank car coupler, etc. It is designed for use with an overhead or locomotive crane which is necessary to move it from one location to another. The illustration indicates how the unit is assembled and how it functions in service.



Group 3 (E)—Air wrench for use in bolting car floors

Straightening ends of freight cars without removing the sheets, stiffeners, etc., has always presented a difficult problem on the light repair tracks. The use of pull jacks and other similar devices are not only dangerous, but their capacity is limited. The machine which we have described has been in service but a very short time but it has proven very satisfactory. It is particularly well adapted to straightening the ends of steel gondola cars and this work can be accomplished in a very short time as compared with other methods.

(C) An all-purpose truck for light-repair-track service. A compact and well equipped unit which includes riveting equipment, car jacks, trestles, acetylene cutting outfit, etc. The details of the assembly are clearly shown in the illustration. The frame of the truck is of lightweight pipe construction, covered by a metal platform and has an equipment box under the platform for small tools, bolts, rivets, etc.

This all-purpose truck carries all the equipment required by a light-repair gang to make repairs to trucks, couplers, etc. Pneumatic tires, wire wheels and lightweight construction make it easy to move from one location to another and it saves considerable time which would be consumed in moving equipment one piece at a time.

(D) Device for applying draft gears to cars equipped with horizontal coupler yokes. The frame of this unit is 9¾ in. wide and 6 ft. long, constructed of two 2-in. by 2¼-in side angles welded together at the ends to cross-members of the same material. At the upper end, curved angles are welded to the side of the frame to form a track which raises the draft gear carriage and sets it in nearly a horizontal position so the draft gear may be pushed over the draft gear support. The upper end of the frame has two brackets which set on the axle of the outside pair of wheels and these are adjustable for height desired with variation in wheel diameters. The draft gear is placed on the carriage at the bottom of the frame and pulled to the top of the curved track by means of a small hand wrench which is equipped with a rachet pawl for safety. The illustration shows the position of draft gear before it has been raised for application.

This device fills a long felt need for a method to apply heavy-duty draft gears on cars equipped with horizontal yokes. Raising draft gears to position with jacks, levers and similar methods is a difficult and unsafe task.

(E) Air wrench for use in bolting car floors. This device consists of an air-motor wrench secured to a platform equipped with three swivel type wheels and a metal tray at one end for supply of nuts. The wrench has a telescoping shaft with the socket on the upper end readily adaptable to variation of floor heights without any adjustment. The operator sits on the platform and propels the unit around under the car with very little effort.

Applying nuts to bolts of car floors with an ordinary hand or motor wrench is a tiresome job and this device makes it much easier for the workman and speeds up the job.

In our study of "home-made" car shop devices, we have developed considerable information and data relative to many other items of equipment. To include all of this detail would involve a voluminous report. We will therefore only mention a few of them which no doubt will be of interest to many. They are as follows:

(1) Car trestles constructed of pipe and scrap boiler plate, welded to provide maximum strength. These are made up in many different types for particular requirements. They are simple in construction and far superior to wooden trestles in safety and economy of maintenance; (2) A wheel base gage designed for mating unit type truck side frames in reclamation shops. Proper mating of truck side frames is an important factor in extending the life of wheels and other truck parts; (3) A combination truck bolster and body side bearing which makes it possible to accurately determine the side bearing clearance in advance of application of truck to car; (4) Portable lumber paint spray machine designed for painting lumber when unloaded at central distribution points. Surplus paint is removed from lumber as it is taken from the machine and returned to the supply tank through a filter. This reduces the consumption of paint to a minimum in this operation.

It is the unanimous opinion of your committee that the opportunity for further study in this field has great and valuable possibilities. In this report we have scarcely touched the surface, and, we heartily recommend that the work of Committee No. 3 be continued at least for another year in the study of home-made car shop devices. We also suggest that the membership be invited and encouraged to submit material for future consideration. It is impossible for the committee to cover the territory which should be investigated and we are certain that there are many devices which should be made available to us.

In conclusion, we desire to extend our sincere thanks to those who were not members of the committee, for their many fine suggestions and counsel. We earnestly hope that what we have brought to you will be of benefit to the association and its membership and we assure you it was a pleasure to serve in this capacity.

The report was signed by R. K. Betts (chairman), foreman car repairs, Pennsylvania, E. St. Louis, Ill.; C. A. Jordan, general car inspector, N. Y. C. & St. L., Cleveland, Ohio; W. J. McCloskey, general car foreman, Illinois Central, Centralia, Ill.; R. P. Dollard, shop engineer, C. & O., Richmond, Va.; P. B. Rogers, shop superintendent, A. T. & S. F., Chicago; H. S. Keppelman, superintendent car department, Reading, Reading, Pa.; E. P. Marsh, assistant superintendent car department, C. & N. W.; and A. Herbster, general foreman, N. Y. C., Chicago.

Discussion

P. P. Barthelemy, master car builder, G. N., said that car shop supervisors should insist on the use of new material for steel ladders, car trestles, etc., in the interest of safety and Chairman Betts agreed that scrap material if applied should be carefully selected to make sure that the sections are corroded slightly, if at all, and have practically the equivalent of new strength. Mr. Barthelemy stressed the use of all possible labor-saving devices to take the manual lifting out of car work, in the interest of safety and increased production.

F. J. Swanson, general car department supervisor, C. M. St. P. & P., Chicago, pointed to the great advantage of concrete roadways at light repair track which make possible the use of lift trucks, enabling four men, for example, to apply 24 pairs of car wheels in eight hours, whereas by the older method, it was a good day's work for one gang to apply 8 to 10 pairs of wheels.

Chairman Betts said that everyone appreciates the value of concrete runways and tractors, but that the expenditure involved is not justified at outlying points where possibly only 10 car men are employed. He said that the labor-saving devices recommended in the committee's report are designed to take some of the manual labor out of car work at these small repair points.

D. J. Sheehan, superintendent motive power, C. & E. I., strongly urged the car men to back up their requests for new equipment and tools with specific information regarding the savings anticipated. He said that car men can get the authority to buy these tools if it is really shown that they will earn their salt. He maintained that extensive improvements in car repair facilities cannot usually be effected overnight and that it is usually more feasible to purchase and install them one at a time.

(*The report was accepted.*)

Maintenance of Streamline Equipment

The advent of the streamliner train and its many diversified changes in body design, truck construction, electric-pneumatic brakes, pretentious interior finishes and fittings as compared to the conventional type of equipment presents a new problem in maintenance to the mechanical personnel of our railroads. Primary consideration is essential in selecting terminal coach yards or shops that can conveniently track or house the equipment during the layover servicing periods, keeping in mind as to whether or not available facilities were adequate for the specific maintenance desired, and if not, if sufficient space was available to accommodate the additional facilities required. Concrete ramp structures and inspection pits equipped with air, steam, water, electric lines and drains, modern electric drop tables and hoists for the removal and application of wheels and trucks complete, machine shops, wheel turning and grinding lathes, electric arc welding machines, electric charging lines of high voltage, power jacks, drill presses, special electric and pneumatic hand tools, to say nothing of the large space required to house stock material were some of the facilities necessary. The next important step is to select supervisors and mechanics who were intellectual, progressive and best qualified to cope with the class of maintenance desired. As a matter of fact a careful selection must be made of the coach cleaners assigned to handle the various cleaning features in order to obtain the most exacting results.

We believe it is agreed that the general maintenance of the conventional type of passenger carrying cars is more or less

identical as amongst all railroads. To some extent, many of the past practices in cleaning and repairs are still in vogue on streamliner equipment, however, there are many added features on streamliner trains where the former practices are not adaptable. Modern and pretentious interior fittings, color schemes, truck and body design, electric-pneumatic brakes, electrical equipment, air conditioning, etc., meant that all concerned were confronted with the problem of devising ways and means of maintaining these new features as efficiently and economically as possible to do so. In addition to the general facilities and tools, consideration has to be given to the kinds of cleaning materials that would be best suited for this work and which incidentally had to be developed through tests in many instances. Railway supply companies have introduced some good cleaning materials and assisted supervisors in every way possible in meeting their various problems. Once the proper kinds of materials are agreed upon, it then becomes necessary to set up a definite schedule with respect to the work that would be performed daily and the frequency in handling of special work. This same procedure is also followed in detail in the periodical over-hauling, testing and lubrication maintenance. With this in mind, the committee has endeavored to describe the manner in which a number of the principal operations are being handled generally.

Interior Cleaning

In the cleaning of interiors, it is the practice to vacuum the shades, drapes, upholstery and carpets each trip of cars into terminals. Electrical appliances operated with the same voltage as carried in the cars, has been adopted for this use inasmuch as the operation can be performed much more rapidly than with the use of the air syphon jet system. Past experience has taught us that in using the air syphon jet system a considerable amount of time was utilized in transporting equipment, particularly the long lengths of hose, from car to car throughout the train yard. Window sills, doors and partitions became scuffed and dirtied in the handling of hose from the yard connections into the cars through the vestibules or windows. Another objectionable feature is the fact that doors or windows had to be left open for the entrance of the hose and consequently flies and other insects entered the interiors and which of course necessitated additional labor in ridding the interiors of these pests after the vacuuming operation was completed.

Further, too much time was lost in connecting and dis-connecting hose each time that the car involved was moved. Spots and stains are removed each trip with a proficient cleaning fluid. When drapes become dirty they are removed for dry cleaning, a complete set of substitute drapes being available for this purpose. Window shades, upholstered seat cushions and backs are washed periodically with a shampoo with sufficient time being allowed for drying in advance of the scheduled departure. Carpets are removed from cars at least once every sixty days and placed on a blow rack platform for a thorough cleaning with compressed air and followed by shampooing. The shampoo referred to is a liquid material which is proportionately mixed with water and forms a foam or sud solution. This sud solution is applied to shades, upholstery or carpets with a sponge and rubbing vigorously. An additional pail of water is used for the frequent rinsing of sponge and removal of dirt. Rinsing water should be kept fairly clean at all times. After cleaning, blowing with compressed air will assist in drying the materials more rapidly and which of course is important where this work is performed on equipment with a short layover period.

As an extra precaution against unnecessary soiling as well as adding to the life of carpeting it is the practice to furnish each car with a canvas aisle strip. Attendants are required to lay these canvas aisle strips on the floor immediately after passengers have been discharged upon arrival of trains at the passenger terminals. Once the cars are cleaned at the coach yards, canvas strips are again laid on carpeted floors and not taken up until just prior to loading time at the passenger terminals.

The same precaution is taken to protect upholstery, particularly the seat arms adjacent to the aisles, by covering with canvas caps. In this manner the upholstered seat arms are not dirtied by the mechanics' overalls as they pass through cars in performance of their servicing work.

Sheet cork, wall paper, photo-murals and the leather pier panels, chairs and shelving are dusted or dry wiped each trip. Periodically, sheet cork is cleaned with naphtha and then given a light coating of lacquer. Wall paper and photo-murals are washed with a soap sud solution, using a good grade of castile soap in lukewarm water and after drying the surface is given a thin coat of lacquer. The application of lacquer serves to protect that finish and extends the duration of time as between subsequent cleanings. Leather is also washed with a good grade of castile soap and water, cheesecloth being preferable for this use. Under no circumstances should polish, oil or ammonia ever be used.

In cleaning (mopping) rubber tiling with inlaid patterns and cemented to a cork flooring it is imperative that a minimum amount of water is used and then removed as quickly as possible. Where an excess amount of water is used and same is allowed to remain on the tiling for a length of time it will work through the cork, pulverizing same and causing the tiling to bulge. This is a matter for builders to consider in future installations.

Painted ceilings, walls, partitions, doors, baggage racks and vestibules are dusted or dry wiped each trip, the scuff marks and spots being removed with a wax dampened cloth. These painted surfaces are being waxed progressively so that each car interior is waxed complete once every ninety days. The waxing operation is confined to certain efficient male cleaners who are thoroughly familiar with its application. A better grade of work is realized in this manner than if the waxing operation was left up to the individual interior cleaners who work in the various cars. An allotted number of hours labor is devoted to this operation daily with a sufficient amount of time remaining in advance of scheduled departure to take care of the removal of handmarks and baggage scuffs that are always prevalent on vestibules, doors, partitions and side walls. In maintaining the painted surfaces with wax it has been proven over a period of time that the finish still retains its original lustre, whereas this cannot be said of the painted surfaces where soap and water have been used. It is a known fact that the repeated use of soap on painted surfaces will ultimately deteriorate the finish and to the extent that repainting becomes necessary.

Multi-vent ceilings or panels are removed for the blowing and cleaning of air ducts semi-annually. After re-applying it is necessary to clean with wax. Where this type of ceiling is used in lounge cars or the smoking rooms of parlor and coaches, the constant presence of smoke results in ceiling panels becoming stained with a yellow color resembling nicotine around the perforations and which can be removed with a wax dampened cloth if attended to frequently. In the absence of frequent attention, waxing proves of no avail and spray painting is required.

Smokestands—we are all familiar with the proper procedure to follow in their cleaning, however we might add that in order to assist in eliminating the objectionable stagnant smoke odors that it is a good practice to remove the ash receptacles from the smokestands for cleaning immediately upon arrival of equipment at the coach yards.

The cleaning of lavatories, windows, basket racks, lighting fixtures and the kitchens and pantries are still maintained in somewhat the same manner as on conventional equipment, therefore we will pass on to our next operation.

Exterior Cleaning

Generally, exteriors are given a plain water wash daily. Periodically they are cleaned with materials best suited for the type of finish, whether it is varnish, lacquer or stainless steel. Green oil soap is very effective in the removal of oil, grease, tarry substances and insects. Regardless of the materials used, it goes without saying that there is a great deal more surface to wash on streamliner equipment as compared to conventional. Diaphragm rubber, skirt sheets and roofs receive the same attention as the body. Where it is the practice to wash roofs each trip of trains into terminals, portable scaffolds with guard rails are the most suitable for the performance of this work, particularly so from a safety viewpoint. These scaffolds are mounted on rubber tired wheels and can be readily moved from car to car along side of trains. In the absence of scaffolds it is found to be a very dangerous practice for men to walk on the roofs. With the prevailing roof curvatures and the fact that oil and water creates a slippery condition, men are apt to fall and become seriously injured. One railroad found that the use of scaffolds would obstruct traffic on the sidewalks adjacent to the trains and at the same time they would not sanction the practice of assigning men to work on the roofs and as an alternative it was decided not to wash the roofs daily, but to take the individual cars out of trains

at least once every ninety days and place on a track where scaffolds could be conveniently used and then scrub the roofs, followed by painting. On these same occasions the rubber diaphragms, skirt sheets and steps are painted.

Trucks were originally cleaned by spraying with a solution of mineral seal oil and kerosene and the resultant glossy effect created a very good appearance, however due to the fact that dirt adhered to the truck parts on this account and might result in concealing such defects as cracks it was proposed that another substitute be found. Some railroads then cleaned the trucks by brushing with a solution of green oil soap and water, while others used a jet system in cleaning with steam and soda solution. Both methods proved effective and left truck parts in a good clean condition and facilitated inspection and repair work. Periodically the trucks are spray painted and restencilled. During the winter month when large accumulations of ice and snow adhere to truck parts, cleaning is important to facilitate inspection and repairs. Usually it is the practice to remove large pieces of ice with a bar and followed by steaming. This procedure dislodges ice accumulations between bolsters, springs, brake levers, side bearings, etc., and will serve to eliminate hard riding complaints.

Mechanical

In dealing with some of the many phases of mechanical maintenance, it was decided that it would not be amiss to commence with inspection work. For after all, it is the inspection that is responsible for the repairs made, especially so in the maintenance of trucks, including wheels and roller bearings. Owing to the importance of this class of work every conceivable precaution is taken. Supervisors in charge of streamline maintenance, being familiar with their fast schedules, realize their responsibility for the safe and on time operation. They in turn have selected the most dependable car inspectors from their organizations for this assignment and they work together and are thoroughly conversant with every detail of maintenance and systematically outline the repairs necessary, daily and periodical. Back of this work the railroad managements have provided elevated ramp tracks and inspection pits to facilitate inspection and repair work. Due to the appurtenance that is now suspended from underneath streamline cars and concealed from view by shrouding and skirt sheets, the ramp track and inspection pit affords car inspectors the opportunity to carefully check all truck parts, brake levers, support brackets and attachments. We know of one railroad who at the present time are constructing a series of ramp tracks and inspection pits. Constructed of concrete the ramp track on which rails are installed are elevated approximately five inches higher than ground level. This height and the height of the rail facilitates inspection and repair work such as the renewal of brakeshoes, hangers, pins, the servicing of roller bearing boxes and the pressure greasing of truck parts. Inspection pits run the full length of ramp tracks and are equipped with water, air, steam and electric lines as well as drains. A series of lateral drop pits for the removal of wheels and other heavy repairs are conveniently located along each track so that several cars in any one train can be undergoing repairs at one time and still not interfere with other maintenance work. Cars are spotted with a car puller.

Repairs to streamline equipment has changed considerably as compared to conventional cars. With increased speed and the endeavor to promote good riding qualities, wheels are condemned for tread wear with special gauges. This practice varies, some railroads condemn wheels with a 7/32 in. tread wear while others remove wheels with only 5/32 in. tread wear. With these gages in use, tread wear becomes the principal defect for which wheels are removed. After wheels are turned in lathe and in order to reduce the margin of eccentricity, some railroads then grind their wheels before application. Stabilizing levels, bolster draft rods, shock absorbers and additional equalizer and bolster springs results in additional maintenance. These parts must be kept in good repair and adjustment to assure good riding qualities. In the absence of ramp tracks with inspection pits, cars are arbitrarily cut out of trains periodically for careful inspection on the regular repair tracks. Terminals handling special work make it a point to thoroughly check and repair trucks periodically, as a matter of fact, complete repaired trucks are substituted as required. Semiannually the trucks and all parts are thoroughly cleaned with kerosense for a hammer test. Due to high speed and the road ballast gradually wearing and having a sandblasting effect on truck parts, metal cross members, steam regulators, etc., it is found necessary to insulate and shield numerous parts. Some equipment has underneath parts sprayed with a rubber cement as often as once every thirty days to alleviate the condition already mentioned. Vertical or flanged tie bars have been introduced and applied to pedestals to prevent the slewing of trucks in the event of a derailment.

Roller bearings, regardless of manufacture, are generally given the same attention at all terminals. Upon arrival of trains the boxes are felt with the bare hand to determine abnormal temperatures. Oil plugs are removed and the oil levels checked, adding oil as required. Where boxes are found operating above normal temperature, the oil discolored, etc., wheels are immediately removed for a complete check of all roller bearing parts. Semiannually the covers are removed for inspection of boxes and the furnishing of Summer or Winter oil. On each occasion that wheels are changed, boxes are completely dismantled for inspection, replacing with new the worn or defective parts found. Originally these boxes were equipped with heat indicators or commonly termed stench bombs that would throw off an obnoxious odor to warn members of train crews if boxes were operating at an abnormal temperature. This method has been improved upon inasmuch as recently built equipment have an electrically controlled signal alarm system connected to each box and when excessive heat develops, it is so indicated in the car interiors.

Lubrication is another matter receiving more attention on streamline equipment. Using air pressure guns, center plates, pedestal liners, slack adjusters and other truck parts are carefully lubricated each trip, and all of which results in reducing wear and improving the riding qualities of equipment.

Air Brakes — Air-Conditioning — Electrical

The introduction of the electric-pneumatic brake have resulted in many changes in our former practices. This class of maintenance meant that mechanics had to be trained and which was done with the assistance of representatives of the air brake companies. Special test racks and test trucks for the testing of valves electrically and pneumatically had to be installed. The added number of brake cylinders, control valves, magnet valves, relay valves, E-3 brake application valves, K-3 switches and speed governors meant more maintenance and by competent mechanics. Testing, cleaning, oiling and repairing schedules, daily and periodically, are strictly adhered to.

It is needless for us to talk about this maintenance as all phases of the operation was ably covered by the Passenger Train Car Handling Committee at our meeting last Fall.

This class of maintenance has increased tremendously due to the additional amount of modern electrical appliances and conveniences now carried in streamline equipment. Additional lighting facilities, water coolers, exhaust fans, shaving receptacles, refrigerators, radios, telephones, speedometers, and back-up horns are some of the added new features and requiring daily attention as well as periodical overhauling.

Will not attempt to relate the amount of daily and periodical attention that is afforded such items as couplers, draft gears, water pressure systems, steam regulators, metallic conduits, etc.

In many instances, work is progressively carried on as between two terminals, therefore work sheets are carried on each train to indicate the work performed, enabling one terminal to pick up where the other left off. Trip inspection reports are also carried in each train for electricians, conductors, and porters to report any unsatisfactory condition occurring enroute and requiring attention.

Work cards are carried in each car to indicate the special work that is required periodically, entries being made on cards accordingly. In this manner, supervisors handling streamline trains have first hand knowledge of the work needing their attention.

Our study developed that the same definite program is followed in the daily and periodical servicing of the power units and auxiliary cars, however in order to keep within the time limit allotted for the presentation of our subject we regret being unable to cover the vast amount of detailed precision work that is required in the maintenance of main engines, traction motors, steam generators, AC and train lighting auxiliaries, air brakes, etc., of these units, but owing to the extreme importance of this class of maintenance we are respectfully recommending to the General Committee that this subject be reviewed at our next meeting.

(Continued on page 433)

A Quarter More Use From

A. A. Raymond,
President

The Railway Fuel and Traveling Engineers' Association report on Utilization of Motive Power outlines methods for accomplishing such an increase—Diesel locomotive operation and air brakes among other subjects discussed at Chicago

At its fifth annual meeting, held at the Hotel Sherman, Chicago, on September 23 and 24, the Railway Fuel and Traveling Engineers' Association presented and discussed a program which by rigid adherence to a time schedule was completed within the allotted two days. Although somewhat curtailed by the enforcement of the schedule, the discussions were brisk and gained in pointedness what they lost in length.

Following the adjournment of the joint opening session of the four coordinated associations, the first session of this association was called to order by its president, A. A. Raymond, superintendent fuel and locomotive performance, N. Y. C. In his opening remarks, Mr. Raymond said that conferences such as this were needed more now than at any time before because of the unusual problems with which railway supervisory forces are faced. These, in part, he said, are the outgrowth of the battle of materials resulting from the tremendous volume of materials and equipment required for our national defense program.

Mr. Raymond briefly reviewed the program for the meeting, pointing out the large amount of work which has been done by the various committees. The best repayment to these men for their effort, he said, would be a good discussion of the reports.

The program was built around three major themes—locomotive performance, including both Diesel and steam; fuel, and air brakes. The greater number of reports were devoted to the steam locomotive, with a new Committee on Lubrication reporting for the first time this year. In addition to the reports and papers abstracted herewith, this session included a report on New Locomotive Economy Devices. The chairman, A. G. Hoppe, assistant mechanical engineer, C. M. St. P. & P., briefly reviewed the performance of the Franklin system of

L. E. Dix,
Vice-President

T. Duff Smith,
Sec.-Treas.

steam distribution with the OC poppet valve and also called attention to the automatic draft control in service on the Lehigh Valley.

The second session was set aside exclusively for the discussion of air-brake subjects, under the chairmanship of J. A. Burke, supervisor air brakes, A. T. & S. F., who introduced the authors of the three air-brake papers.

A report on Plugged Netting—Cause and Cure was presented by a committee, of which H. Malette, road

Locomotives Suggested

W. C. Shove,
Vice-President

J. A. Burke,
Vice-President

foreman of equipment, St. L.-S. F., was chairman. This will be the subject of an article in a subsequent issue.

During the meeting the association was addressed briefly by John M. Hall, director, Bureau of Locomotive Inspection, I. C. C., and Roy V. Wright, editor, *Railway Mechanical Engineer.*

Address by J. M. Hall

In a brief address, J. M. Hall, director, Bureau of Locomotive Inspection, I. C. C., spoke in terms of the higher praise of the performance of the mechanical and operating departments during the present time of stress. At the beginning of the last war, he said, 54.5 per cent of the locomotives inspected by the bureau were found defective, while now only 9 per cent of the locomotives inspected are found to be defective. That, he suggested, is one reason why trains now keep moving with so few delays.

Mr. Hall cited figures to show the tremendous improvement in locomotive conditions as reflected by the reduction in accidents and casualties caused by the failures of locomotive parts since 1916. The safe machine, he said, has proved to be the good machine. Along with the reduction in failures has gone a reduction in the cost of boiler maintenance and in fuel consumption. Except where caused by hidden defects, Mr. Hall said, there never should be a boiler explosion and there never would be if maintenance and operating forces were all awake. In closing, Mr. Hall said that the traveling engineer can do much through his personal contact with the engineman to overcome the opposition on the part of some of them to the operation of the blow-off cock required in the blow-down system of preventing foaming.

Remarks by Roy V. Wright

Mr. Wright, called upon during the meeting, spoke briefly concerning the situation of the railroads in the national defense program, calling attention particularly to the needs for material and equipment. They were making good, he said, by mobilizing their man power and he stressed the possibilities offered by making better use of the human element. He cited one example of this as the prevention of accidents. He quoted the National Safety Council's estimate that for 1941 the nation would suffer an economic loss of 3.6 billion dollars as the result of accidents. A great deal of this loss he considered preventable and stressed the need for safety campaigns as the activities of the railways increase.

The Road Foreman and the Diesel Locomotive

By W. D. Quarles

General Mechanical Instructor, Atlantic Coast Line

In December, 1939, the Atlantic Coast Line and the Florida East Coast inaugurated faster daily service between New York and Miami with our deluxe trains, "The Champion," Diesel powered between Washington and Miami, and typical of Diesel passenger operation throughout the country.

This improved service established itself so permanently in the public's favor that 19 2,000-hp. Diesel passenger units (18 Atlantic Coast Line and 1 Florida East Coast) were added to provide Diesel power for the "Vacationer," the "Florida Special" and the bigger "Champion." The original "Champion" consisted of seven light-weight cars powered with one 2,000-hp. unit; this being increased to fourteen light-weight cars and two 2,000-hp. units. The "Vacationer" and the "Florida Special" were powered with 4,000- and 6,000-hp., respectively.

As further evidence of the fine service rendered by the Diesel locomotive, the Atlantic Coast Line and the Florida East Coast now have on order twelve additional units (9 Atlantic Coast Line and 3 Florida East Coast) to Dieselize other Florida trains for the coming winter season. With the units now on hand this will give us a total of 34 passenger units, all of which have been purchased in the past two years.

We have good steam locomotives on our line but they have not been successful in their operation on high-speed trains.

No Power Failure in 2,700,000 Miles

August 1, 1941, the combined mileage of our road Diesels aggregated 2,704,000 miles without a power failure necessitating replacement by steam, and as a consequence of this performance, we do not have stand-by protection for Diesel power.

On July 12, Train No. 2, operating between Miami and New York (mixed streamlined and conventional equipment) was wrecked at Walthourville, Georgia, due to striking and knocking a cow into a switch stand of the center passenger track. This was an opposing switch; it was opened, and both power units and seven cars were derailed. The speed of the train at the time of the accident was 75 m.p.h. The power units were rerailed and moved into our Waycross, Georgia, shops on the afternoon of July 14, where only steam facilities were available; however, the

units were conditioned and returned to service on July 18. This reference is made to indicate the sturdiness of this type of power.

We do not have Diesel freight power as yet. but one only needs to observe the service rendered where this type of power is used to determine its ability in fast-freight service.

All concede the Diesel switcher's supremacy to the steam. We have two types of Diesel switchers on our line and careful records are being kept to determine the type best suitable for future purchases.

The Diesel locomotive, at present, is used largely in the high class passenger service, where the schedules are the fastest and the service more exacting. If the road foreman desires this to be what is expected, he must spend his time with the men in order to educate and acquaint them with all phases of the operation.

Diesel-Electric Throttle Technique

The handling of the throttle of the Diesel-electric locomotive compares in no way with the handling of the steam locomotive's throttle. It is in this that the electric equipment can be subjected to severe abuse and high maintenance costs. The engineman should know what takes place in the power room when the throttle is moved from idle position to position No. 8. If the operation of the electro-pneumatic governor and load regulator is understood, no trouble is experienced from these men failing to use the proper time element between throttle positions; when accelerating or decelerating, time must be had to permit the Diesel engine to respond and assume the new speed for each throttle position. This also gives the load regulator time to balance out with the new load demand. When too much time is consumed in advancing the throttle, the traction motors stay in series longer than necessary, and as transition is delayed, several power plants may transfer at once, giving an objectional surge to the train.

In steam-locomotive operation no serious results are obtained by opening and closing (pumping) the throttle; however, if this practice is used on Diesel-electric locomotives it causes destructive arcing at series and field contactors, unnecessary wear and removal of parts and rough handling of the train.

The engineman should know that at speeds below 30 m.p.h the acceleration should be made with traction motors operating in series. If acceleration takes place with traction motors operating in parallel there will be improper application of power to the traction motors, the high amperage flow causing heating, and loss of power for acceleration.

When passing over railroad crossings the engineman should know that the vibration causes poor contacts between brushes and commutators on traction motors, which results in arcing and burning of commutators. When the throttle is in position higher than Run No. 2, the voltage and currents will be high; by reducing the position of the throttle to Run No. 2 this is minimized and the prevention of the flash-overs in the motors is assisted.

With the light-weight streamline trains having little or no slack in draft rigging, no trouble was experienced when these trains were started. However, now that Diesel-electric power is handling trains which consist of mixed streamlined and conventional equipment, or all conventional equipment, the question of throttle manipulation is of great importance, as well as the methods used in stopping trains of this make-up. The characteristic of traction motors is to develop a high torque when starting, with resultant high drawbar pull, and on runs where there are two or three power units the slack is sometimes taken out severely and rough handling occurs, especially at the rear of the trains.

The writer has found that, first, much can be done to relieve this by stopping trains with slack stretched, making one application of the brakes and using graduated methods when releasing brakes; second, where two or three power units are handling trains, one or two power plants were isolated until the train slack was stretched, or the train started. This practice eliminated the trouble in starting and slack was controlled.

Training Firemen for Road Maintenance

On our line at present we have an electrical supervisor riding all road Diesels. He is just what the name implies; he has a knowledge of the equipment not yet obtained by the crews. Firemen assigned to Diesel-electric locomotives will perform all duties in the power room necessary for correct operation, and make any repairs required, under the direction of the electrical supervisor. The electrical supervisor is subordinate to the road foreman of engines.

With this method of operation we have developed assistant road foremen, firemen instructors and firemen, who are thoroughly capable of being trusted with the care and operation of our Diesel locomotives.

The fireman of today is the engineer of tomorrow, and by hiring firemen not for their brawn, as was the case in the past, but young men with a high-school education and a natural aptitude for railroad work, we should perfect an organization for Diesel road operation which should function as well as steam operation and with the same supervision.

Discussion

Prof. L. E. Endsley said that the railroads are coming to Diesel locomotives faster and faster and that the best steam locomotive today uses six times as much fuel as the Diesel-electric locomotive. With five-cent oil, he said, the balancing price for coal would not be over $2 per ton. He prophesied that in 20 years no more steam locomotives would be purchased unless steam develops faster than he believes it will.

Mr. Wink (A. C. L.) said that it was not difficult to teach any man in 30 min. to run a Diesel-electric locomotive, but that he cannot be taught to take proper care of the engine in any such short time. The fireman, he said, on his tours every 20 or 30 min. looks after the equipment and is thus trained to know its requirements. In closing, Mr. Quarles referred to the much greater number of Diesel locomotives than of steam which have been ordered during the current year and agreed with Professor Endsley that steam is on the way out.

High-Speed Braking With D-22 Control Valves

The D-22 control valve has several improved features among which are the quick service feature; service stability; positive release regardless of service slide valve friction; improved graduated release feature; improved emergency transmission speed; improved release after emergency application; increased capacity; more uniform brake cylinder pressure; simplified construction and interchangeability with previous equipment.

Improved brake flexibility and sensitive control in the hands of the enginemen assist in the maintenance of intensive schedule, add new safeguards to operation, and the equivalent automatic cushioning of intratrain shocks are also characteristics of new passenger train brake types.

[The report included a summary of the advantages of the present electro-pneumatic braking systems with particular reference to the features which control wheel sliding. A detailed description of such equipment as applied to one of the Burlington Twin Cities Zephyrs was also included.—Editor.]

There are a number of high-speed trains being operated throughout the country with speed governor control but without wheel slide protection, and are not having much trouble with slid flat wheels, but the secret for this in most cases, is that generally only light brake applications are being used for making slow downs and stops. In most instances these light brake applications do not exceed the braking forces employed on older equipment, and as a result the motive power is called upon to maintain higher maximum speeds to offset the time lost by the brakes being applied earlier than it normally would be necessary if wheel protection were used. If, however, the maximum of 200 to 250 per cent braking forces were used in ordinary service braking, there would be a far different story, and the necessity for ample sanding with some form of wheel slide protection would be recognized at once. In our opinion these high braking forces should be available at all times without fear of damage to wheels; they can be available with the equipment now at hand

Officers Elected for 1941-42

***President:* L. E. Dix, fuel supervisor, T. & P., Dallas. Tex.; *vice-presidents:* J. A. Burke, supervisor air brakes, A. T. & S. F., Topeka, Kans.; E. E. Ramey, fuel engineer, B. & O., Baltimore, Md.; W. C. Shove, general road foreman of engines, N. Y. N. H. & H., New Haven, Conn.; *secretary-treasurer:* T. Duff Smith, Railway Fuel & Traveling Engineers' Association. *Executive Committee—elected to serve 2 years:* E. Holmquist, master mechanic, C. & N. W., Chicago; A. G. Hoppe, assistant mechanical engineer, C. M. St. P. & P., Milwaukee, Wis.; H. W. Sefton, superintendent locomotive and fuel performance, C. C. C. & St. L., Indianapolis, Ind., and W. R. Sugg, superintendent, fuel conservation, Mo. Pac., St. Louis, Mo.**

For service braking the use of electric straight air brake is of prime importance on fast schedules, as the brakes can be applied throughout any length of train to the desired brake cylinder pressure in two to four seconds, depending on just how fast it is desired to build up the pressure; this depends on passenger comfort and the liability of sliding wheels.

The handling of the brakes on trains operated with electro-pneumatic brakes is no more difficult than braking an automobile and requires very little instruction on the part of the road foreman. The advantage of electro-pneumatic braking on mountain grades is that the air brake system remains fully charged, so that in case of an emergency the full braking power is always available. The use of retainers is unnecessary and the train speed can be controlled more uniformly than it is possible with automatic brake; due to the ability of applying and releasing in uniform cycles, the wheels and shoes remaining comparatively cool, thus reducing brake shoe wear and saving of wheels from damage due to over heating.

One fact is evident, that is the positive application of sand in sufficient quantities and so delivered that its full benefit is realized for tractive purposes, will provide a coefficient adhesion under all conditions at least as high as that obtainable with a clean dry rail. If a rail adhesion efficiency was available at all times a brake design of much higher capacity could be developed to predict stops with greater confidence and accuracy. The subject of adequate sanding of the rail to insure uniform wheel rail adhesion is being constantly studied, but not as yet fully solved. Some railroads have gone so far as to install additional sanding devices in two or more locations of one train, being arranged so that at a predetermined cylinder pressure automatic sanding will occur. On others sanding is initiated by wheel control operation. The additional sanding stations were judged necessary, since when wheels pass over sand at high speed the sand which is not blown from the rail or carried by the wheels at the brake shoes and lost, is ground so fine it has lost its efficiency by being repeatedly crushed.

However, even if a sanding device could be designed to efficiently sand the rail at 90 to 100 m.p.h. the problem of carrying a sufficient supply of loose sand on each truck for a usual trip of the present streamline trains is a major one.

It therefore appears definite to us that some other method of conditioning the rail must be devised for satisfactory results at the present high speed.

Electro-Pneumatic Sanding Equipment

The effectiveness of good clean silica sand to raise the coefficient of adhesion between the rail and wheel is unquestioned, but reliability of sand delivery introduces major problems.

The sanding equipment is designed to solve these problems in a practical manner. It is flexible and can be operated either pneumatically or electro-pneumatically. The pneumatic operation of the equipment is interlocked with the brake equipment so that its operation is initiated by an emergency application of the car control valve and continues over a predetermined time before being terminated automatically, thereby eliminating a useless waste of air and sand. The electro-pneumatic operation is controlled through electric circuits which are used at the discretion of the engineman to initiate or terminate a response simultaneously at all sander installations through the train. If not terminated by the engineman, an electro-pneumatic sanding operation will cease by action of a timing sanding valve in the cab after a predetermined time interval. The train sanding circuit is interlocked with a locomotive sanding circuit in such a manner that either the locomotive sanders alone may be used for locomotive traction when accelerating, or all train sanding stations may be simultaneously set into operation when desired.

Sand is dispersed positively and reliably to the point of contact between the wheel and rail by a new type of sand trap which includes a device for preventing high pressure air for cleanout purposes from blowing back into the sand box. The sand is conveyed from the sand trap to the point of application through a sanding hose and distensible rubber nozzle from which it is delivered. The sand trap is so designed that a minimum of compressed air is used to deliver the sand to the rail, atmospheric air being used in large quantities for agitating the sand within the trap.

The sand trap has two distinct functions. First, at the beginning of every sanding operation a short, but heavy, cleanout blast of air is directed through the sanding hose and nozzle to insure an unrestricted flow of air and sand. This cleanout blast of air may develop any pressure in the delivery line needed to open the sanding nozzle if it should be frozen over on the outside during winter weather. Second, sanding follows immediately after the cleanout blast. Another cleanout blast of air follows automatically at the termination of the sanding function.

The cleanout and sanding cycles of a group of traps at one station are controlled automatically by a sanding relay valve, which comprises a relay portion for providing the sequence of functions, a magnet portion for responding to the electro-pneumatic control, and an application portion for automatically responding to a local emergency brake application. The air supply is provided by a separate reservoir, which is charged through a valve which prevents interference with brake action.

The railroads are very much concerned with three principal factors affecting wheel service, shelling, thermal cracks and tread wear. Shelled wheel treads cause rough riding, and vibrations from this increase maintenance costs. To remove wheels for turning involves expenditure in tread metal and the cost of their removal and replacement. Thermal cracks require removal of tread metal or possibly the scrapping of the wheels when cracks are discovered. It is feared greatly as a possible source of broken wheels and possible derailment. Tread wear affects contour, riding qualities and as wear progresses the removal of wheels for reconditioning.

The report was signed by H. I. Tramblie, air-brake supervisor, C. B. & Q., and John Battise, general air-brake instructor, C. & N. W.

Discussion

J. Fahey (N. C. & St. L.) referred to the use of two conventional cars in the lightweight streamline train which operates over the N. C. & St. L., stating that with these cars in the train a higher-brake pipe reduction is required than when the streamline equipment is operating alone. He inquired if, when brakes reapply after brake-cylinder pressure has been reduced by the speed-control devices, the reapplication increases the cylinder pressure on other cars. Mr. Tramblie called attention to the relatively large tonnage which had been added to the train with the two conventional cars and said that these cars, having a lower braking ratio, required heavier brakepipe reductions to effect the same control.

J. Kane (N. Y. C.) inquired whether there is any difference in the functioning of the Decelostat and the wheel controller and asked whether the wheels actually slid when under the control of these devices.

In answer to this question Mr. Tramblie said that with either type of wheel control the wheel does not stop turning, sometimes slowing down not more than the equivalent of 10 miles an hour. When wheels slide, he said, retardation is only 20 per cent as much as when rotating; with the slip controlled the retardation never got below 60 per cent through the complete cycle of the operation of the device.

J. P. Stewart (Mo. Pac.), referring to the experience of the Missouri Pacific with the HSC brakes on streamline trains, said

that there had been very little maintenance cost with these brakes. Once men use the electro-pneumatic brake, he said, they do not like to go back to the automatic brake. He referred to a run on which two lightweight cars equipped with HSC brakes move in one direction regularly in a train of nine conventional cars and said that the performance was entirely satisfactory, with no slack action or rough handling. Up to September 10, he said, the high-speed trains on the Missouri Pacific had made 3,251,584 car-miles and 582,464 locomotive-miles, with five pairs of slid-flat wheels on the cars and two pairs on the locomotive, both on idler wheels. He advocated buying new passenger-car brakes with D-22 control valves with the idea that sooner or later they will be converted to the full HSC schedule.

Terminal Tests and Road Handling of Long Freight Trains With Mixed K and AB Equipments

A fundamental requirement for every air brake engineering problem is that new and improved apparatus must not be introduced unless it will operate in harmony with and contribute towards the improved operation of the existing brake apparatus. The AB brake equipment was designed on this basis so that when it is mixed in trains of cars having the type K brake equipment, it not only functions better but it also improves the functioning of the train brake as a whole.

The benefits which are realized from the installation and use of the AB freight car brake equipment can be classified under two headings. The first class of benefits relates to the improved operation, which is especially important in the safe and smooth control of long trains, that is, trains made up of more than 100 cars. The second is lower maintenance costs which result from constructional features that make a longer cleaning period feasible and better inspection and repairs possible.

The lower maintenance costs have been well demonstrated by the repair shop experience which has now become quite general. As the percentage of AB brake increases, the shop facilities and methods will be perfected so that the minimum costs will be assured, but for the purposes of this discussion we are primarily concerned with operation characteristics. It is the improved functions of the AB brake which make possible the satisfactory control of long trains now in service, even when they have a considerable percentage mixture of the old style K brakes. A comparison of the K and AB brakes shows that the outstanding differences are in the application and release, which are the fundamental brake functions.

The integrity of the AB application is very much improved over that of the K because it has a superior form of quick service, which is a three stage limited type as compared with the continuous type used in the K. The AB quick service is initiated by a movement of the piston and graduating valve only, whereas the K quick service must wait on enough pressure differential to move the main slide valve. When the AB graduating valve moves it causes a rapid drop of brake pipe pressure into a fixed volume, which initiates and propagates quick service through the train and this is followed by a further drop at a slower rate by venting to atmosphere until the slide valve moves to produce the application of the individual brake. In this manner the effect of slide valve resistance on the quick service action is eliminated and the speed of propagating a service application throughout a long train is thereby greatly increased.

The initial quick drop starts a pressure wave that travels along the pipe rapidly to start the next valve, where the action is repeated so that when quick service is initiated it will travel with full speed and make every valve apply in the longest train. This action is not duplicated by the continuous type of quick service in the K because high slide valve resistance can delay its initiation at any car for varying time periods and, consequently, it may sometime fail to propagate a light application throughout a train of 100 or more cars. The more dependable and vigorous quick service action of the AB is such that any mixture of those valves in a K train will assist in making the K valves more certain to apply and thus insure a better train brake control.

The speed and reliability of the release function of the AB brake is also greatly improved in two ways. The first is the quick recharge feature provided by the added emergency reservoir and the second is the release insuring feature which eliminates the slide valve friction as a factor in delaying or preventing an intended release.

The emergency reservoir remains fully charged during a service application. When a release is started and the first slide valve moves to release position, a port opens which connects the emergency reservoir to the auxiliary reservoir. This port is controlled by the graduating valve and it functions to recharge the auxiliary reservoir, without drawing any air pressure from the brake pipe, until after the two reservoirs are nearly equalized. This feature makes it possible to raise the brake pipe pressure to the releasing point throughout a long train within a shorter time than is possible with K valves which draw air from the brake pipe as soon as the release starts.

The AB release insuring feature is built in so that with the valve in service lap position and the brake pipe pressure raised 1½ lb. above the auxiliary reservoir pressure, the insuring valve will open and vent auxiliary reservoir pressure until the rapidly increasing pressure differential forces the valve to its release position. This vent is cut off when the slide valve moves and if the slide valve resistance happens to be equivalent to 1½ lb. or less, it will not occur. Thus this device only function to vent when necessary and then only to the exact degree required to release a valve having high slide valve friction. It thereby eliminates any chance of a release failure due to a combination of slow brake pipe pressure rise and high valve friction.

The improved AB application and release features have been briefly described here because they have an important bearing on the successful handling of long freight trains. While the full advantage of AB brakes can only be obtained with 100 per cent AB equipment, as AB brakes are mixed with K brakes, the improved functions become more effective and it is feasible to extend the train length and thus take increased advantage of the high capacity of the modern locomotive.

Terminal Tests

It is good practice to begin terminal tests when a train enters a terminal. The engineman should apply the brakes by making a full service application before the engine is detached from the train. The car inspectors can then begin inspection to see that each brake is applied and check for long piston travel or any other visible defects.

At this time cars with defects can be marked so that the necessary repairs or adjustments can be made at a time and place designated by the yard master and thus avoid any delay in the switching of the train. Close cooperation between the inspectors and yard master for handling these repairs will work out to good advantage. A yard compressor plant for charging trains in the terminal will be a very valuable aid for reducing the brake system leakage as well as for making the required terminal tests.

Charging

1. Water condensation and dirt must be blown from the line from which air is taken before connecting the yard line or locomotive to the train.

2. The train must be charged to the standard pressure. The retaining valves and retaining valve pipes must be inspected and known to be in suitable condition for service. The position of angle cocks, cut out cocks and hose connections must be checked. The train brake system must be examined for leaks and necessary repairs made to reduce leakage to a minimum.

3. The terminal test can be made from a yard plant provided the equivalent of an automatic brake valve is available and connected to same point in train that engine is to be attached, otherwise this test must be made after the road locomotive is attached. When test is made from a yard plant, a road test must be made before the train is permitted to depart.

4. In preparing to make terminal or other tests it must be re-

membered that an AB equipped car requires at least seven minutes to charge from zero to 70 lb. Frequently charging passages are restricted and a greater length of time is required to charge such cars. If an attempt is made to apply such brakes without allowing time for them to charge sufficiently, they will fail to apply, and may be undercharged to the extent of indicating false brake pipe leakage. In order to overcome this condition 12 min. should be allowed for charging and on some trains it may be necessary to extend the charging time to 15 min.

Test

1. When the train is known to be charged within 5 lb. of full brake pipe pressure, as indicated by locomotive gauge, a 15 lb. service reduction must be made upon proper signal or request and the brake valve handle then placed in lap position. The brake pipe gauge on the locomotive must then be observed for one minute to determine the brake pipe leakage in terms of pounds drop in one minute. It is preferable that this leakage should be less than 5 lb. but it must not exceed 7 lb.

2. Following the leakage test the brake pipe service reduction must be increased to 20 lb. The train must then be examined to determine that the brakes are applied in service application on each car, that the piston travel is not less than 7 or more than 9 in. and that there is no binding or fouling in the brake riggings.

3. Excessive brake pipe leakage must be reduced to a point where it does not exceed the maximum value permitted and all cars found with wrong piston travel must be adjusted to near the nominal value of 8 in.

4. When this examination is completed and upon the receipt of a proper signal, the brakes must be released by using a brake valve manipulation that will avoid overcharging. Each brake must be examined to see that it releases.

5. Other defects found during these tests which can not be repaired promptly must be reported to the inspector foreman or the conductor for appropriate action. The inspector or trainman who made the examination must personally advise the engineman and conductor, giving the number of cars in the train and the number of cars which have inoperative brakes.

6. At points where motive power, engine crew or train crew are changed terminal test must be made.

Road Test

1. On a freight train, before an engine is detached or an angle cock closed on an engine or a car, the brake must be fully applied. After recoupling and opening the angle cock and before proceeding, it must be known that the brake pipe pressure is being restored as indicated by the caboose gauge and that the rear brake released. In the absence of a caboose gauge the inspector or trainmen will note that the rear brakes of train apply and then signal for a release, noting that rear brakes release.

2. When one or more cars are added to a train at any point subsequent to a terminal test the cars added, when in the position where they are to be hauled in the train, must be tested as prescribed in terminal test above. Before proceeding, it must be known that the brake pipe pressure is being restored as indicated by the caboose gauge and that the rear brakes are released.

Train Handling

The mixture of AB brakes with K brakes in freight trains raise the train length limit for safe and satisfactory handling, and this rise will be roughly proportional to the percentage of AB brakes introduced. The benefits derived from a given number of the new brakes will be greatest if they are uniformly distributed through the train.

The percentage of all freight cars that are equipped with AB brakes is increasing rapidly and on some railroads which have a large percentage of their home cars equipped, the average number of AB brakes in regular trains is well over 50 per cent. Several of these properties are taking advantage of the resultant better brake performance and are operating trains both loaded and empty in regular service, which are well over 100 cars in length, ranging upwards to as high as 150 cars.

In all cases where AB brakes predominate and the new valves are fairly well distributed, the dependable functioning of the train brake is not the problem it would be if all brakes were of the K type. However, the smooth handling of such trains does involve many problems which the engineman must be prepared to solve as they arise. This subject is exceedingly complicated because there are numerous governing factors which can vary widely and consequently the space and time here available will permit a citation of the more important aspects of long train operation.

The fundamental consideration for smooth train handling is the control of the relative slack movement between different portions of a train which can occur because of the slack or lost motion which always exists between the couplers and the draft rigging of the cars. The total slack is made up of free or unresisted movement caused by wear on the coupler pulling faces and in the draft rigging, plus the travel of the draft gears at each pair of couplers. The total slack is sometimes measured by noting the change in the train length between having the train compressed with the slack all in and having the train stretched with the slack all out, but such a measurement is only relative because a greater slack change can result under some service conditions due to forces which often exceed the maximum drawbar effort.

The freight car draft gear commonly has a working travel of 2½ in. in each direction. That is, from its neutral position the coupler shank can be pushed inward 2½ in. or be pulled outward 2½ in. against the resistance of the gear. The total slack movement that comes from the draft gear is 5 in. per gear or 10 in. per car. In compression or extension the gears are being closed against the resistance of the gear friction. When the slack reverses, the gears are being expanded by their release springs and, since the force exerted by these springs as modified by the friction elements comes into play just when the slack movement has started to reverse, it can often combine with other forces acting on the train to accelerate the rate of slack change.

The free slack motion is a much smaller portion. The amount will depend on the normal knuckle clearance and the degree of wear in couplers and draft rigging parts. Test records indicate that the average free slack for all freight cars is in the neighborhood of one inch per car which means that the total slack is around 11 inches per car. On this basis the total slack movement possible in trains will be about 91 ft. for 100 cars, 110 ft. for 120 cars, 137 ft. for 150 cars, etc.

If long trains could be tightly coupled and have rigid draft rigging of sufficient strength, all slack movement would be eliminated. The locomotive would then need enough power to start all cars in the train at the same instant. Any force such as power, braking, track grade, track friction, train friction, etc., which might be applied to any portion of the train would be instantly transmitted to every car in the train. Under such circumstances it would not be possible to have damaging shocks with any method of train handling. This is purely an imaginary condition which is not practicable, but even if it could be accomplished it would be unsuited to long train operation.

When a car begins to move there is a sharp decrease in the journal friction so that the draw bar pull required to keep it moving is much less than that which was required to start it moving. It is this journal friction characteristic which makes train slack movement very essential for starting trains when the tonnage is closely matched to the power of the locomotives. From this standpoint the existence of train slack is so beneficial as to make it a necessity, but from the standpoint of train handling it offers some serious problems in avoiding objectionable shocks.

Any train en route is continually subject to varying forces which act to either accelerate or retard it. The locomotive pull on a down grade will produce acceleration, whereas the frictional resistance, up grade and brake action are some of the forces that will produce retardation. These forces are seldom effective on the whole train but usually affect it in different parts and to a varying degree so that the different parts of the train will tend to assume different speeds. Whenever such a difference can act to run the slack from all in to all out or vice versa, some portion of the train will be subject to a shock at the instant the slack movement ends and all parts of the train are forced to assume the same speed.

The degree of shock will depend on how fast the slack is moved, the weight of the train portions and the yielding resistance of the draft rigging through which the forces must be transmitted when the slack run ends. The serious and sometimes damaging shocks occur when force differences are allowed to develop which can run the slack in or out rapidly. If the engineman uses due care in manipulating the throttle and the brake control in combination with a knowledge of the slack status and the track conditions, it is often possible to avoid a slack reversal and nearly

always possible to avoid a run of the slack which will be fast enough to produce any rough action.

The locomotive throttle is an important factor in slack control because it can be manipulated so as to prevent or at least slow down a run of the train slack under many conditions. It is usually expedient to open or close the throttle gradually so that the train slack can adjust itself slowly as the engine effort is changing.

The serial action of the brake is perhaps the most important consideration in the control of train slack movement. When a train brake is either applied or released its action is always propagated from the point where it is started. In other words, after the brake action begins on the first vehicle there is a time interval to the functioning of each succeeding brake.

For application the front brakes of the train can develop heavy retardation before any braking is effective on the rear cars. If the train is running forward with the slack stretched, this serial development of the retardation can generate heavy forces which will tend to cause a slack closure. Likewise, if the train is running forward with the slack compressed and the brake is released, the serial action can generate heavy forces that will tend to run the slack out. The propagation time for both the application and release functions is roughly less than one-half for a solid AB train compared to a train made up of all type K valves. This shorter time, combined with the controlled quick service action of the AB brake, greatly reduces the tendency of the brake serial action to run the slack so that for any given set of conditions it will be easier to control the movement of the slack in proportion to the admixture of AB brakes. In every case where a brake manipulation is required the engineman must keep these tendencies in mind and govern the control of power and braking so that a rapid change on the slack can not occur.

The many combinations of conditions which can affect the rate of train slack change are so numerous that it is not possible to cover the subject fully in this discussion. However, the following comments relate to certain circumstances that are typical conditions for long train service and will point out some of the more important methods of manipulation which are usually employed to prevent or retard the movement of the slack in these trains.

Assuming that a train of all loaded cars is moving forward on a straight level track with the locomotive working hard to hold the train stretched and the need for a stop is indicated, the engineman must move the throttle slowly to the closed drifting position and allow the train to drift. The internal resistance of the engine combined with the draft gear recoil action on the cars will start the slack to move inward slowly. After waiting a suitable time for the slack to adjust itself and thereby reduce the forces which were stored in the draft gear, a light service application reduction of not over 6 pounds can be made.

If the train speed is low, 15 m.p.h. or less, and particularly of the brake pipe leakage is considerable and K brakes are numerous in the front portion of the train, it may be advisable to use steam when the brake application is started because these factors tend to increase the velocity of slack movement and, as the speed becomes lower, the effectiveness of a given brake application will increase rapidly with a corresponding tendency to run the slack too rapidly. If the speed is high enough and conditions require, a second application reduction of about 8 lb. can be made to complete the stop after sufficient time has elapsed following the initial 6 pound reduction to allow a complete adjustment of the slack. This time may be about 20 seconds after the brake valve closes for the first reduction when on level grades, but may be much longer when the rear portion of the train is on a hump or curves.

Where the conditions are the same as stated above, but there is not sufficient time and distance to make the stop in the manner described, a heavier application, say a 10-lb. reduction, can be started promptly with the locomotive throttle open and the locomotive brake held released. In this manner the tendency of the heavier brake application to run the slack in rapidly will be modified by the pull of the locomotive. As the train slows down, the throttle must be closed gradually to suit the working of the engine and be in the closed position about 40 ft. from the final stop. At this time the locomotive brake must be applied sufficiently to avoid an excessive strain on the tender draw bar at the instant of final stop.

The manipulation described is only a rough outline of methods which can be used to control slack movement. The set of conditions assumed are subject to many modifications which may require corresponding changes in handling in order to avoid objectionable shocks. For example, if in the stop zone the forward part of the train is entering curved track or is encountering some up grade, these conditions will produce retardation force that will add to the brake serial action forces which act to drive the slack in. In some instances, these forces may be great enough to close the slack roughly without a brake application so that it is necessary to have the locomotive exert some pull until the slack closes to the point where it is safe to start the brake application.

Another factor which has an important bearing on the method of handling is the load distribution when trains are made up with a mixture of empty and loaded cars. A given degree of brake application will change the speed of a group of empty cars much faster than it will change the speed of a corresponding group of loaded cars. This ratio of difference in rate of speed change can be as much as 2 or 2½ to 1. Whenever the cars are distributed so that these uneven rates of retardation can cause a difference of 3 or 4 m.p.h. speed in separate parts of the train before the slack movement is completed, an internal collision or severe jerk must result as the point is reached where the slack is all in or all out. It is necessary for the engineman to know how the train is loaded and modify his manipulation of the throttle and the brake so that a serious speed difference can not develop within the train before the slack is adjusted.

The releasing of the brake when the train is in motion is often difficult to accomplish without a serious jerk shock because the train slack is often compressed during the preceding brake application. The release starts and runs serially from the head end and this will tend to run the slack outward. Under some conditions the retarded release feature of the K valves, combined with AB slow release, will be sufficient to allow the slack to move out gently. If loaded cars are grouped on the head end or the train is passing into down grade it may be necessary to hold the locomotive brake applied sufficiently to prevent a fast run out of the slack during the train brake release. When conditions will permit the train slack to be gently stretched before the brake release is started, there will be little danger of a rough run out.

Care must be exercised when stopping trains that are backing. The pushing of the locomotive will usually have the slack compressed so that if the throttle is closed and the brake is applied, a fast outward slack movement towards the rear is certain. The usual practice for such stops is to make a light brake application with the throttle open far enough to keep the slack pushed in until the brake application can become effective throughout the train.

The practice of attempting to make spot stops of long trains for taking water and coal often produces rough handling. The reason is that this procedure usually involves the use of the brakes at very low speeds where even a light application of the locomotive or train brake is apt to be highly effective and produce correspondingly heavy slack action. It is a better practice to stop a long train smoothly at a point where some latitude is available and then cut the locomotive off for fuel and water.

The successful handling of long freight trains involves a slow movement of the train slack both in starting and stopping. The slack can not be changed both quickly and smoothly at the same time. The time element is very important in all brake operations and this importance increases as the train length increases. In the unusual cases the engineman must use good judgment regardless of any general instructions.

In conclusion we wish to point out that the only hard and fast rule for the smooth handling of long freight trains can be expressed in three words, which are, "Change slack slowly." It is not always easy to follow this rule because the correct method of handling must be modified according to track grade, track curvature, train loading, train length, type of cars, type of locomotive, effectiveness of brakes and other conditions of less importance. The engineman must study how these controlling conditions vary for different trains at each stop location and then do the needful. Experience has shown that with careful operation trains of mixed AB and K brakes as long as 150 cars can be successfully handled in daily service.

The report was signed by F. T. McClure, assistant supervisor of air brakes, A. T. & S. F.

Discussion

J. Kane (N. Y. C.) spoke in favor of making slow-downs of freight-trains with an open throttle and with the locomotive brakes released. In many instances, he said, the brakes on long trains handled in this way can be released without stopping the

train after a slow-down. This saves fuel, he said, as does also the reduction in the number of break-in-twos effected by this.

J. P. Stewart (Mo. Pac.) objected to the statement that there is 11 in. of slack in each car; without carefully qualifying it, the statement is misleading when all but 1½ or 2 in. of this possible total movement is cushioned and not shock producing.

J. Fahey (N. C. & St. L.) said that since the practice of braking against the open throttle had been in use on the N. C. & St. L. there had been no pulled drawbars. He said that freight trains are operated at 60 miles an hour and can be handled almost as smoothly as passenger trains by this practice.

O. E. Ward (C. B. & Q.), commenting on the amount of slack in freight trains, suggested that the Railway Fuel and Traveling Engineers' Association was the appropriate body to undertake an investigation to see if it is not possible to get along with less slack. He said that the handling of freight trains is no longer a tonnage proposition, but a matter of time, and suggested that the air-brake companies could make a real contribution to improvement in this respect if the AB brake could be made to charge a little faster.

W. H. Davies (Wabash, retired), called attention to the effect of differences in the braking ratios on the cars in a long train which may cause slack to run in and out at several points in the train. This can be avoided by the open throttle which assists in the adjustment of the slack gently. As to the effect of this practice on fuel consumption, he said that the division where this practice was started received the banner for the best fuel performance.

H. W. Sefton (C. C. C. & St. L.), cited as one of the reasons for the greatly improved train-handling conditions now as compared with 35 or 40 years ago the marked reductions in brake-pipe leakage. In braking trains with the open throttle he pointed out that the throttle need not remain fully open until the stop; it can be eased off after the slack has adjusted itself.

In his closure Mr. McClure agreed with Mr. Sefton as to the easing off on the throttle. In commenting on the time required for charging the AB brake he said that some of the delays charged to this cause could be eliminated. For instance, when cutting new cars into a train en route they could be recharging while the locomotive is moving them into the train.

Elimination of Oil and Water in Air Brake Systems

The assignment of the above subject for this paper clearly infers that the presence of oil or water in excessive amounts in air brake systems is undesirable, and the Committee is willing to go a step further and say that both are detrimental to flexible brake operation. The effective control of oil and water in air brake practice is often difficult to accomplish because the factors responsible are numerous and frequently very complicated.

When an excessive amount of oil is passed into the train brake system it usually originates in the lubrication apparatus of the compressors. The heat resisting lubricating oil used for the compressor air cylinders will not dissolve or evaporate into the air as water does, yet it will often travel from the compressor through the main reservoirs, brake valves, and appear in the train pipe in sufficient quantity to flood the pneumatic devices. This is a bad condition which interferes with proper lubrication, introduces dirt, damages rubber materials, and is frequently responsible for erratic brake action.

The primary cause for excessive oil is the lack of proper lubrication control. It is essential that the oil feed for the lubrication of compressor air cylinders be carefully regulated to provide the right amount of oil at a rate that will correspond to the rate of compressor labor. Too little lubrication is objectionable because it reduces the compressor life but over lubrication leads to train brake trouble which are just as serious.

Hand controlled lubricators such as the hydrostatic type can be used but they must be frequently checked and adjusted. The preferred type of air compressor lubricator is a device or cup which will automatically feed a measured quantity of oil that will be proportional to the compressor speed.

Compressor condition is a secondary factor in the passing of oil into the brake system because the oil must pass through the main reservoir in the form of an atomized vapor. When the air cylinder piston rings are a poor fit on the cylinder walls and the piston grooves, the numerous small leaks will atomize the oil so that it can travel a considerable distance through the piping before it resumes a liquid form. Otherwise, an excessive amount of oil fed will only pass through the air cylinders and be trapped in the main reservoirs. For this reason it is important that care and good workmanship be used to insure an accurate ring fit on true cylinder walls, correct piston clearance and good ring groove fit when compressors are overhauled in the shop.

The detrimental effect of free water in the air brake system makes itself manifest in two ways which are: first, by destroying the lubrication, and second, by freezing.

The passing of water through the pneumatic valve mechanisms not only washes away the lubricant on the rubbing surfaces, but it carries much dirt and grit along with it to come into contact with the wearing parts. This causes exceedingly rapid rates of wear at critical points which, in turn, result in costly premature failures in service along with much higher repair and maintenance costs. It also causes greater than normal friction between rubbing parts, which often means erratic operation that can interfere with smooth and reliable brake control.

The usual sources of this water are badly designed yard air plants and locomotive main reservoir air storage systems. In both cases it is a question of designing and arranging the apparatus between the compressor and the train so that all excess liquid moisture is removed from the air pressure before it is introduced into the train. The considerations which govern good design for adequate moisture control are rather complicated and in order to make them more easily understood, we will first discuss the general aspect of the laws which govern moisture as it is transmitted by air.

When air at any pressure is in the presence of water, the water will evaporate or dissolve into the air. If the air is very dry the rate of this evaporation will be relatively fast, but as the air nears the point of saturation the rate of evaporation will become slower and it will cease at saturation because then the air will have absorbed all the water it can hold; that is, the air in question will have attained a relative humidity of 100 per cent.

Since absolutely dry air has a relative humidity of 0 per cent, any value for relative humidity between 0 and 100 per cent is merely a measure of the amount of water dissolved in the air compared to the amount that air will hold when it is fully saturated.

The amount of water, measured by its weight, or volume, necessary to saturate a given quantity of air is dependent on two physical conditions. These conditions are: first, the pressure acting on the air, and second, the temperature of the air.

When the pressure of a given quantity of air is increased by reducing its volume but without a change in temperature, the total amount of water it can absorb to become saturated to 100 per cent humidity is decreased. When the temperature of a given quantity of air is increased without a change in pressure, the amount of water it can absorb will be increased. It follows that these characteristics are reversible; that is, if the air pressure is lowered by increasing its volume, the maximum possible water content will be raised, and if the air temperature is lowered, the maximum possible water content will be lowered.

These characteristics are illustrated by the curves of Fig. 1. The data of the curves plotted on this figure relate to a quantity of air measured as 10,000 cu. ft. at atmospheric pressure. This is the amount of free air contained in a cube measuring 21.6 ft. on each side and its actual weight is about 764 lb. Fig. 1 shows how the number of quarts of water necessary to saturate this quantity of air, horizontal scale, decreases as the air pressure is raised from atmosphere to 140 lb. per sq. in. gage pressure, vertical scale. This figure also shows how the amount of water necessary to saturate the same quantity of air, horizontal scale, increases with the increase of the air temperature, vertical scale.

Inspection of these curves indicates that for an increase of both the pressure and the temperature these characteristics are of opposite effect; that is, for increasing pressure the saturated

water content decreases, and for increasing temperature the water content for saturation increases. It will also be obvious that the pressure effect is relatively very much less than the temperature effect within the ranges of pressures and temperatures chosen.

Assuming that a given quantity of air is saturated to 100 per cent humidity, it will be noted from the data of these curves that any decrease in the pressure or increase in the temperature will reduce the degree of humidity to something less than 100 per cent. The air in either case will thus be able to evaporate some additional water before it will again attain a 100 per cent humidity. On the other hand, if the pressure is increased or the temperature is decreased, the relative humidity cannot go beyond 100 per cent and so a cloud of condensed excess moisture forms in the air. If the change continues, rain will begin to fall.

The effect of pressure and temperature of the air on its degree of relative humidity is well illustrated by the curves drawn on Fig. 2. This diagram shows how the relative humidity of saturated air changes as the pressure or temperature of the air changes. The horizontal scale is the pressure scale for the straight lines and the temperature scale for the curved lines.

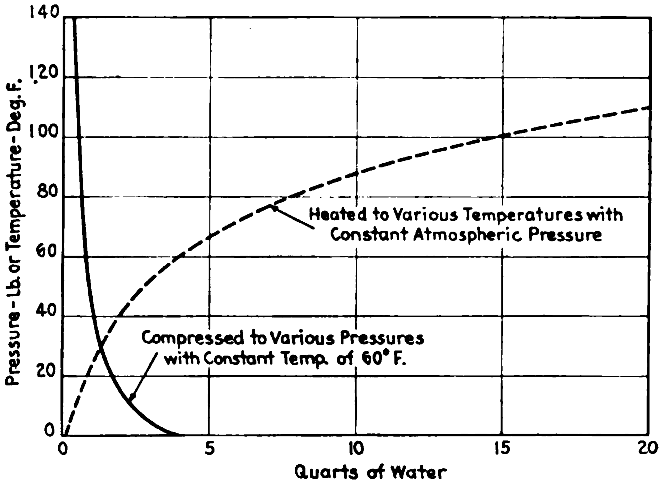


Fig. 1

Referring to Fig. 2, it will be noted as an example of what the straight line pressure curves show that if any given quantity of air is at 100 per cent humidity and compressed to a pressure of 140 lb. per sq. in., the expansion of this air from a pressure of 140 to 110 lb. per sq. in. will reduce the relative humidity of the air from 100 to 80 per cent. Likewise, referring to the curved line, if a quantity of air has a temperature of 50 deg. F. with 100 per cent humidity and the temperature is raised to 70 deg. F. the relative humidity will be reduced to 49 per cent. In other words, at this point in the temperature scale, heating the air 20 deg. F. doubles its ability to hold water. By the same token, cooling this air to a 20 deg. lower temperature will approximately halve its capacity to hold moisture.

Here again we see that within the temperatures and pressure ranges we have to deal with in operating air brake systems, the temperature effect is relatively much greater than the pressure effect and therefore it is the dominating factor in the designing of compressor plants so as to accomplish a satisfactory control of moisture. This is not only true for air brake systems but it also applies to all other kinds of pneumatic apparatus in which the presence of free unevaporated water cannot be tolerated.

The conditions which surround the operation of the air brake differ from those of other pneumatic apparatus in that all of its elements are operated out of doors and they are therefore subject to wide range of temperatures which extend from a maximum of 130 deg. F. downward to, and sometimes far below, the freezing point at 32 deg. F.

The entrance of moisture into the brake system takes place at the compressor suction in the form of water that has been evaporated into the free air drawn in for compression. The maximum amount of water is encountered when the atmospheric air around the suction strainer is at 100 per cent relative humidity.

We have previously stated that whenever air is in contact with water it will take up some water by evaporation until it is saturated, after which there will be no further absorption unless the air is then heated to a higher temperature or has its pressure reduced. Since the atmospheric air can generally contact damp objects such as the earth, plant life, rivers, lakes, etc., the humidity of the ambient atmosphere tends to be relatively high except in districts where it is exceptionally dry and arid. In case it is raining or when there is fog or mist, the relative humidity is 100 per cent. Since the latter condition occurs frequently or at least occasionally in nearly every locality it is necessary to design locomotive air compressor plants so that they will effect a proper control of the moisture under this maximum condition.

While the degree of atmospheric humidity which any given locomotive will encounter is dependent on the service location, the rate at which compressed air is used is also an important factor, because the total amount of water to be handled will depend on the amount of pump labor as well as on atmospheric humidity. It is therefore apparent that locomotives which regularly work in long freight train service in humid localities such as certain coast lines will be subject to the worst conditions for moisture.

Assuming that the atmospheric air entering the compressors at the strainers is at 100 per cent humidity, both the pressure and temperature of this air are increased rapidly as the work is done to bring it up to main reservoir pressure. The effect of these changes on the degree of relative humidity are opposed and tend to offset each other, but since the effect of the temperature rise is much the greatest the compressed air arrives at the compressor discharge at something less than 100 per cent humidity. The proof of this condition is the fact that free water is never found in or even near the compressor.

As this heated air at main reservoir pressure leaves the compressor discharge and flows along the discharge pipe, it cools rapidly so that a point is soon reached, usually a few feet from the compressor, where the falling temperature causes the relative humidity to rise to 100 per cent or the saturated value. This is sometimes called the dew point since it is at this point that a cloud of fog forms to start the deposit of all water that the compressed air is unable to hold evaporated.

From this point the air flows through the discharge pipe, the first main reservoir, the radiating pipe, the second main reservoir and thence by way of the main reservoir pipe to the control or distributing valve and brake feed valve. During this journey the cooling effect continues to reduce the temperature and thus more of the moisture is forced out of the air to be deposited along the path of its flow. When the air arrives in the main reservoir pipe ready for distribution to the air brake system, it will be at main reservoir pressure and 100 per cent humidity for its temperature, which should then be very close to the temperature of the surrounding atmosphere.

The use of the compressed air, either at the control or distributing valve or in the train brake pipe through the brake valve and feed valve, will be accompanied by a rapid expansion to a lower pressure. The expansion of the air will cause a sudden decrease in both the pressure and the temperature and since the temperature change has the greatest effect, a small quantity of moisture will be deposited locally at these expansion devices. However, as the air flows on at the now reduced pressure, its temperature will quickly rise again to near atmospheric temperature by absorbing heat from the piping so that its relative humidity will drop to a value considerably below 100 per cent.

For example, and referring again to Fig. 2, the data of the straight lines show that if the main reservoir pressure arrives at the brake valve at 100 per cent relative humidity and 140 lb. pressure and is then expanded into the brake pipe to 110 lb. pressure, the relative humidity will drop to about 80 per cent when the expanded air has recovered the same temperature it had before the expansion. Likewise, if the main reservoir pressure is 110 lb. and the brake pipe pressure is 70 lb., these data show that the relative humidity will drop to about 68 per cent.

The brake pipe pressure during release and recharge will average less than 110 lb. for passenger and 70 lb. for freight service and therefore the relative humidity of the air flowing through the brake pipe will be somewhat lower than 80 and 68 per cent. respectively. Air in this condition will be able to evaporate additional water and consequently if the compressor air storage system is designed so that the compressed air is cooled to near atmospheric temperature when it leaves the second main reservoir, the air brake system will always be dry.

The foregoing discussion seems to justify the conclusion that the proper control of moisture in pneumatic systems is a rather simple matter. However, experience with some locomotives designed in recent years has shown that the locomotive builders have a very serious problem in designing and locating the compressor plant elements so that they will meet the requirements as outlined. The ability of the pipe and reservoirs of any main reservoir layout to accomplish adequate cooling will depend on their size, and on how they are located so as to always have a free circulation of cooling atmosphere around them.

The economy of the modern steam locomotive has brought with it the use of many kinds of auxiliary apparatus, all of which must be suitably located. The air compressor plants also have a larger delivery capacity which means increased size for all the elements and thus in certain cases it becomes exceedingly difficult to secure an ideal or even a passably good location for every part. The streamlining of locomotives frequently operates to shield parts of the main reservoir system and this may prevent the proper circulation of air around its parts, with the result that the effectiveness of moisture elimination is greatly reduced.

The control of water in compressed air systems for air brakes is accomplished by designing the main reservoir piping and locating the capacity volumes so that the air will be sufficiently cooled during the maximum rate of flow to insure that the air supplied to the brake devices will have a degree of humidity something less than 100 per cent or saturation. The volume reservoirs can be used to collect moisture as it is deposited by the cooling air, but they must be located so as to have the greatest possible protection against the radiation of heat from the boiler or fire box. Otherwise, any water trapped in these reservoirs will be re-evaporated by the air and thus carried along perhaps to some vulnerable point in the air brake system.

The piping is an effective element for radiating the heat from compressed air because it provides a large cooling surface in proportion to the volume of air it contains. This function is dependent on having the pipe so located that atmospheric temperature air can circulate freely around it.

The reservoirs are relatively ineffective for radiating heat from the air, especially during the period of maximum air flow. This is because the heated air stream will not disperse, but will flow along the top of the reservoir so that the cooling effect is not much more than the equivalent to a pipe of the same length as the reservoir. In severe winter it is not uncommon to see icicles clinging along the bottom of a main reservoir when it is warm to the touch along the top.

It is not difficult to make frequent checks, under different weather conditions, on the ability of any locomotive main reservoir system to properly control the moisture in regular running service. It is only necessary to note whether water is seeping from the hose couplings of the train en route or at the end of a trip when the hose coupling is parted to uncouple the locomotive. A satisfactory main reservoir system will not cause the hose couplings on the tender and first cars to be wet if it is properly designed.

In some installations it may be necessary to place a drain cup in tender brake pipe. The function of the tender drain cup is to trap the water which is deposited at the point of expansion in the feed valve and hold it until the brake pipe air of relatively low humidity can re-absorb it. The quantity of the water involved is not sufficient to materially increase the relative humidity of the brake pipe air, but it is objectionable if this unevaporated water can enter the train brake pipe.

We have shown that the proper moisture control function of an air brake main reservoir system is dependent on a number of factors, such as variations in climatic conditions of humidity and temperature, the rate of air flow encountered, air pressure values used, etc. These factors are in turn dependent on the type of service for which the locomotive is intended and on the weather conditions which will prevail in its working territory.

Places to Look For Trouble

Reservoir Location—The reservoirs must be located where they will have free circulation of the atmospheric air around them and so that they will receive a minimum of heat radiated from the locomotive boiler and fire box. The purpose of these requirements is to secure a maximum cooling of the air stored in the reservoirs and to avoid any re-evaporation of water deposited in them.

Compressor Discharge Pipe—The pipe which connects the compressor discharge to the first main reservoir must also be located so as to have this maximum circulation of atmospheric air and a minimum exposure to heat radiated from the hot locomotive parts. This pipe must be installed with as many lineal feet of lengths as can be used without dropping the temperature of the compressed air at the first main reservoir inlet below 32 deg. in freezing weather. If this pipe is made too long, there may be trouble from freezing, but experience indicates that in most installations the discharge pipe can be as long as 45 ft. The moisture control function of this pipe is to cool the compressor air to as near atmospheric temperature as practicable without freezing near its delivery end under the most unfavorable conditions of compressor labor, high atmospheric humidity and low atmospheric temperature. It must be located so that all moisture deposited in it can drain toward the first main reservoir.

Radiating Pipe Between Reservoirs—The pipe connecting the first and second main reservoirs must also be designed and located so that it will be well ventilated and protected against heat radiated from the boiler and fire box. The function of this pipe is to reduce the temperature of the compressed air to as near atmospheric temperature as possible. When the atmospheric temperature is above freezing a small amount of deposited water will be delivered from this pipe to the second main reservoir but if the temperature of the air surrounding this pipe is below freezing, this water must be stored in this pipe as frost and it will remain there until the atmosphere temperature rises above freezing or the locomotive is housed in a place warm enough to melt the frost. For this reason this intermediate pipe must not be small in diameter and it may be much longer than the discharge pipe if greater length will aid in placing it where it can be most effective as a heat radiator. This pipe must be installed so that any free water precipitated in it can drain towards a reservoir.

Compressor Suction Strainer—The location of the compressor inlet strainers must be chosen in a place where they can receive clean, cool air and where they will not be exposed to the steam vapor of leaks which can occur around the cylinders and certain steam operated auxiliary devices. Any steam vapor entering the strainer is equivalent to raising the relative humidity of the atmospheric air and the margin for safe moisture control will be correspondingly reduced.

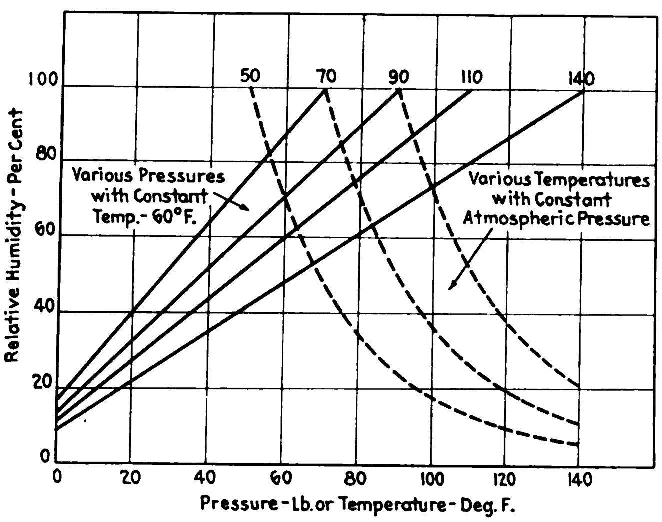


Fig. 2

Main Reservoir Supply Pipes—The location of the supply pipes to the brake valve and the control or distributing valve is not of great importance from the standpoint of moisture control. If the location of this pipe is such as to reheat the air en route to the brake valve, this may be of some benefit by reducing the amount of water deposited at the feed valve and the same is true for the air expansions that take place in the control or distributing valve. If these pipes are located where they are exposed to low atmospheric temperatures and they freeze, it is evidence that the other elements of the main reservoir system are not properly performing their cooling functions.

General Considerations

Occasionally, extra large or special purpose locomotives may be encountered on which the best feasible location of the reservoirs and radiating pipes will not give satisfactory control of moisture. In these cases, it will be compulsory to find a space somewhere on the locomotive such as between the frames or on the front end where additional radiating pipe can be installed in the line leading from the second main reservoir to the brake apparatus. This pipe can be of any required length, but it must be arranged so that the moisture deposited at any point in it can drain toward a trap reservoir. The trap reservoir must be large enough to hold all the water that can accumulate between drainings so that it will not be possible for any of this water to pass into the brake system.

In recent years very good moisture control has been accomplished for some large steam locomotives by installing an aftercooler in the main reservoir supply pipe; that is, in the pipe between the last main reservoir and the brake equipment devices. The aftercooler is made up with about 35 ft. of finned copper tubing, arranged as eight lengths in parallel between suitable headers. This device is installed on the frame just ahead of and shielded from the smoke box and it is equipped with an automatic drain valve that can eject any deposited water during each cycle of the governor operation. Some of these locomotives work in mountainous territory where they often pass from mild damp weather to extreme cold. There has been no report of freezing troubles nor indication that any moisture has passed into the train brake systems.

The Frisco Lines has been interested in the subject of aftercoolers or fin radiators for some years, making a trial installation on a Mountain type locomotive in 1936. As a result of this trial installation, to date 26 locomotives of this type have been equipped, with eight more on schedule. The cooler on these locomotives is in the discharge pipe between the compressors and the first main reservoir, and is mounted under the smoke box where it has a free circulation of air around it.

There are three main reservoirs on these locomotives (two on left side, one on right side) located under running boards where they have a free circulation of air around them. This installation was carefully followed to get an accurate check on the amount of water deposited in the reservoir and other appliances. There was no indication of water beyond the second main reservoir. In addition to the Mountain type locomotive, six semi-streamlined Hudson type locomotives have been equipped with the aftercoolers. On these locomotives the aftercooler is located between the first and second main reservoirs and is mounted on the front end under the streamlining cover in which an opening is cut out and covered with front end netting to provide for air circulation. Frequent checks under a wide range of weather conditions have shown the moisture control is satisfactory on these locomotives.

The fundamental requirement for the elimination of water in air brake systems is the cooling of the compressed air to a point where its temperature is within a few degrees of the temperature of the surrounding atmosphere. On many modern locomotives it is difficult to accomplish this unless some form of high efficiency heat radiation is used. The finned copper tube radiator described above has not only given excellent results in all its applications on the Frisco Lines, but it has been equally successful on other railroads.

In conclusion, the committee called attention to the need for keeping dust and dirt out of the compressor air cylinders. The significance of what will be accomplished by providing clean air for the compressor suction is well illustrated by the experience on the Frisco Lines which has now made the Type G suction filter standard equipment. Before this action was taken compressors used in the "dust bowl" territory required laundering once a month and once every three months in other districts. Since the filters were applied all laundering has been stopped and the shop records indicate that for two compressor installations the service life between compressor overhauls is at least four years. The important savings from the annoyance of failures and high maintenance costs will be obvious.

The report was signed by Frank Ellis, general air-brake instructor, St. L.-S. F.

Discussion

S. M. Roth (Western Maryland) told of a series of tests conducted by the Western Maryland on one of its recently built single-expansion articulated locomotives which substantiated the conclusion in the report as to the elimination of water effected by the use of the aftercooler.

After the new articulated locomotives were delivered, he said, trouble was experienced with water during the winter of 1940-41. An aftercooler was installed on one of the locomotives for test. The aftercooler is mounted on the front of the locomotive and part of it is connected between the air compressors and the main reservoir. The air discharge from the main reservoir passes through a 2-in. coil, thence to a sump and through the second portion of the aftercooler. Another sump is placed between this portion of the aftercooler and the second main reservoir. The tests, he said, were only completed on September 22 and a full report of the results are not yet available. He said, however, that the temperature of the air after it had passed through the aftercooler was only two degrees above the atmosphere. A large amount of water was discharged after the air had passed the aftercooler, and the air in the brake pipe was dry.

Turbine and Condensing Locomotives

During the last few months, and more than ever before, there has been special consideration and interest in connection with certain details of locomotive design. Two of these are the matter of so constructing the locomotive that the entire weight will be carried on the driving wheels; and the matter of using high-tensile light-weight material and refinement of design which will permit a locomotive of considerable horsepower capacity to be built in one unit.

In its report for 1939 and again in 1940, this committee proposed the use of gas or combustion turbines as the prime mover for locomotives. As stated in these reports, the Allis-Chalmers Manufacturing Company of Milwaukee, Wisconsin, had their engineers make a very thorough study and research in connection with using combustion turbines for furnishing power on locomotives. The consensus of opinion of the engineers of this company is that:

"With regard to the development of the gas turbine for application to heavy traction, nothing has occurred to change our opinion that this type of power generating unit can be applied to such service. The studies made two years ago indicate that, when the gas turbine unit is designed for a maximum operating temperature of 1,000 deg. F., both the efficiencies and weight-power relations are feasible. At the same time, it was recognized that increasing the inlet temperature to the gas turbine would improve the efficiency and also reduce the weight of the equipment for a given power.

"Since the studies two years ago, attention has been given to the development of gas turbine equipment for higher temperatures. At the present time, such a gas turbine is in the development stage. The development program includes the construction and complete testing of this equipment at a higher temperature. It was, therefore, deemed advisable to delay the active development of gas turbines for locomotives until the higher temperature test results of this experimental unit are available. . . .

"The metallurgical phase of the problem has also been given considerable attention. Development work is under way on new materials that show promise of being substantially better than the older alloys used in steam turbine or gas turbine work up to the present time. An extensive research program on metals is being continued, with every prospect that the results will aid further in the direction of increasing the upper temperature limit."

This committee is greatly encouraged by the whole-hearted confidence of the Allis-Chalmers Manufacturing Company's engineers who are making so thorough a research in this important development. We are satisfied that, when high-tensile, lightweight alloyed metal is again available, that it will be possible and practical to design and construct a gas turbine powered locomotive of 6,000 hp. capacity in one unit, and in this unit, carry sufficient

fuel and water to supply the locomotive during a 500-mile run, providing a direct mechanical transmission is used.

[The report then presented general specifications for a 6,000-hp. gas-turbine locomotive in a single cab unit based on the drawings and description of the 5,000-hp. locomotive set forth in the 1939 report.—Editor]

The report was signed by L. P. Michael (chairman), chief mechanical engineer, C. & N. W.

Coal Equivalents of Locomotive Fuels and Power

Those who are familiar with the interpretation of locomotive fuel performance statistics generally recognize the comparisons of the performances of different railroads in the common terms of pounds of coal per unit of service—thousand gross ton miles, passenger train car miles, yard engine hours—have little significance beyond the indication that may be given that there are fundamental differences in the general conditions having to do with location, construction, facilities, equipment, character of traffic, and requirements of service, which affect the operations of the different roads.

Under present instructions the monthly consumption of each of the various kinds of fuel and power is reported to the Interstate Commerce Commission by each railroad "reduced to their equivalent in net tons of coal, using such ratios of equivalence in heating values as the experience of the respondent indicates are applicable to local conditions." These quantities, stated as net tons of coal, are combined in the statistical statements of performance for the various districts and regions and for the Class I railways as a whole, and inevitably there is some tendency toward the drawing of comparisons between the published performances of individual roads, even between those that use different kinds of fuel and power.

For many years fuel-department men on the railroads have been concerned over the wide variation in the "coal equivalent" values used by the different railroads and the subject has been considered in several reports by the Committee on Fuel Records and Statistics. In its report for 1940 this committee showed the following ranges of values in use on thirty of the largest Class I railways:

	Minimum	Maximum	Average
Coal—B.t.u. per lb.	10,295	14,000	12,500
Fuel oil—gallons per net ton of coal...	115	215	161
Diesel oil—gallons per net ton of coal..	15	215	45
Gasoline—gallons per net ton of coal...	15	223	97
Electric current—kw. hr. per net ton coal	350	2,000	1,084

These coal equivalents used by different roads were reported to be based upon various methods of determination such as "comparative service tests," "comparative service performance," "data based upon tests," "comparative heat content and thermal efficiency," "coal consumption per kw. hr. in company plant," "coal consumption per kw. hr. in public utility producing plant."

The report and the discussion of the report brought out the point, with which there was no disagreement, that "a consistent equivalent value would be one that would produce a fuel unit, in pounds of coal per 1,000 gross ton miles, of the same order of value as that produced on the same territory by coal-burning locomotives in the same kind of service," and therefore, that "the conversion factor should be such that a road using electricity, fuel oil, gasoline or Diesel fuel could at any time return to the use of coal without affecting the value of the fuel performance units" on the territory in question.

Our Executive Committee has assigned to the Committee on Fuel Records and Statistics this year, the task of proposing forms of procedure for the determination of coal equivalents for each of the several fuels and power commonly used and reported on O. S. forms, that would to a reasonable extent meet the statistical requirements of equivalence as stated above, for presentation to the various roads through appropriate channels with the suggestion that serious consideration be given to their adoption.

In approaching this assignment your committee desires to make it clear that the members entertain no thought that any one set of arbitrary formulae should be proposed as suitable for all roads or even for all conditions on any one road, and certainly it is not to be expected that the same equivalent values could be considered applicable to every road in the country. Each particular situation undoubtedly requires individual study and treatment with due consideration to the conditions by which it is governed. However, there is no reasonable justification for the extreme variation in values that the present reports show, and we believe that this range in values could be very greatly reduced, with consequent improvement in the reflection of the existing situations, if more careful consideration were given by many roads to the determination of the actual conditions which apply to the problem and to the proper procedure to be followed in establishing the coal equivalents.

The most truly representative and consistent values of coal equivalents are those developed by qualified personnel from actual observation and study of the fuel consumption and the service units produced by the fuels or power in question as compared with the coal consumption and the service units produced by coal burning locomotives in the same service. Where this procedure is not practicable and reliance must be placed upon theoretical treatment or calculation by formulae we favor the procedure that takes into account for each of the fuels being compared, the known factors that are favorable and those that are unfavorable through the medium of suitable constants carefully worked out and properly applied. These constants should take into account any differences in the amounts of the fuels consumed incident to the preparation of the locomotives for service as well as any differences in the efficiency with which the fuels are utilized by the locomotives in service on the road, since in every case all the fuel issued to the locomotives is a charge against the service they perform and enters into the calculation of the fuel performance units.

With these considerations in view we have set up in following sections suggested forms of calculation to determine the coal equivalent of each of the several kinds of fuel and power, and by way of illustration have tabulated the results of such calculations for a few selected values of the factors involved, which we consider to be fairly representative of actual practice in each case.

Coal Equivalent of Fuel Oil Burned in Locomotive Fireboxes

The factors involved in the proposed formula are:

Fuel	Factors	Values used in example,
Coal	(1) B.t.u. per net ton.	25,000,000 (12,500 B.t.u. per lb.)
Coal	(2) Per cent of the total coal disbursement used on road (total less consumption for terminal servicing of locomotives).	90
Coal	(3) Per cent of efficiency of the combustion of the coal.	65
Fuel oil	(1) B.t.u. per gallon.	135,000
Fuel oil	(2) Per cent of the total oil disbursement used on road (total less consumption for terminal servicing of locomotives.)	96
Fuel oil	(3) Per cent of efficiency of the combustion of the fuel oil.	76

Example: 25,000,000 × .090 × 0.65 ÷ 135,000 × 0.96 × 0.76 = 148 gallons per net ton.

Factors 2 and 3 may be combined into a single factor for each fuel representing the efficiency of its utilization. Thus, $0.90 \times 0.65 = 0.585$, representing the efficiency of utilization of the heat content of the coal under the conditions assumed for the example. Likewise $0.96 \times 0.76 = 0.73$, representing the efficiency of utilization of the heat content of the fuel oil under the conditions assumed for the example. These two factors may also be combined into one, thus, $0.585 \div 0.73 = 0.80$, which may be considered the efficiency of the utilization of the coal relative to the utilization of the fuel oil. Such a factor may for convenience be referred to as the utilization factor of the coal relative to the oil.

The proposed formula will then take the following form: (a) B.t.u. per net ton of coal × (b) utilization factor of coal relative to oil ÷ (c) B.t.u. per gallon of oil = (d) fuel-oil coal equivalent, gallons per net ton.

With the thought that a range from 0.75 to 0.85 for this factor will embrace the limits of any ordinary service conditions experienced, we have prepared the following tabulation to illustrate

the probable limits of the values for fuel-oil coal equivalents in gallons per net ton, considering coals of from 13,500 to 11,500 B.t.u. per pound and oils of from 130,000 to 140,000 B.t.u. per gallon.

Fuel Oil-Coal Equivalent—Gallons Per Net Ton

Coal, B.t.u. per lb. and per ton	Fuel oil, B.t.u. per gallon	Gallons per net ton		
13,500 per lb. 27,000,000 per ton	130,000	177	166	156
	135,000	170	160	150
	140,000	164	154	144
12,500 per lb. 25,000,000 per ton	130,000	163	154	144
	135,000	157	148	139
	140,000	152	143	134
11,500 per lb. 23,000,000 per ton	130,000	150	141	133
	135,000	145	136	128
	140,000	140	131	123
Utilization factors of coal relative to fuel oil		0.85	0.80	0.75

Kilowatt Hours Equivalent to One Net Ton of Coal

The formula proposed by your committee follows the method of comparing the amount of work measured in kilowatt hours produced by a ton of coal consumed by steam locomotives, including the coal consumed in terminal servicing, with the amount of electric current measured in kilowatt hours that must be purchased or generated and metered to the transmission system for the production of the same amount of work by the electric locomotive.

The factors that must be known or determined for use in the computation are:

1. The average number of pounds of coal consumed by the steam locomotives per horsepower hour, and the equivalent per kilowatt hour, one kilowatt hour being equivalent to 1.34 hp. hr. Dividing 2,000 lb. by this number of pounds of coal per kilowatt hour gives the equivalent number of kilowatt hours of work produced by the steam locomotives per ton of coal consumed.

2. The average combined efficiency of the electric transmission system and the electric locomotives with allowance for standby consumption of the locomotives. The reciprocal of this value shows how much greater must be the gross amount of electric current procured than the net amount actually converted into work by the electric locomotives, which latter value we compare with the work output and corresponding coal consumption of the steam locomotives.

The proposed formula takes the form shown below: 2000 ÷ pounds of locomotive coal per kilowatt hour × 100 ÷ percentage of combined electrical efficiency = coal equivalent, kilowatt hours per net ton.

Example:—Factors—(1) 4.0 lb. of coal per hp. hr.
or 5.36 lb. of coal per kw. hr.
(2) 70 per cent combined electrical efficiency.

2000 ÷ 5.36 × 100 ÷ 70 = 533 kw. hr. per net ton of coal.

With the thought that a range in factor (1) from 3 lb. to 8 lb. per hp. hr., and a range in factor (2) from 60 to 80 per cent combined electrical efficiency will embrace within their limits any ordinary service conditions, we have prepared the following tabulation to illustrate the application of the proposed formula and to indicate the probable proper limits of the values for coal equivalents in kilowatt hours per net ton.

Kw. Hr. Purchased Per Net Ton of Coal

Steam locomotive factors: Lb. coal per hp. hr. of work produced	Lb. coal per kw, hr. of work produced	Kw. hr. of work produced net ton of coal	Kw. hr. of electric current purchased or produced per net ton of coal				
3.0	4.025	497	825	765	710	662	621
4.0	5.360	373	621	574	533	497	467
5.0	6.700	299	498	460	426	398	373
6.0	8.050	249	415	384	356	332	312
7.0	9.380	213	353	328	305	284	266
8.0	10.720	187	311	288	268	249	234
Per cent of combined efficiency of electric			60	65	70	75	80
transmission and electric locos.—(reciprocals)			1.67	1.54	1.43	1.33	1.25

Gasoline—Coal Equivalent

The correct calculation of the equivalent value of coal consumed in steam locomotives as compared with gasoline consumed in locomotives or motor cars propelled by internal combustion engines in the same service, must be based upon knowledge of the combined thermal and mechanical efficiencies of the respective types of locomotives in the particular service and the proportions of the total coal disbursed to the steam locomotives and the total gasoline disbursed to the gasoline locomotives that is not utilized in doing the work because it is consumed in terminal servicing or in standby loss. If exact information is not available, at least a close approximation upon each of these features can and should be determined and used.

If, for example, the locomotive efficiency of the gasoline locomotives is established as 12.5 per cent and it is determined that 4 per cent of the total gasoline disbursement is consumed in terminal servicing and standby loss, the resultant fuel utilization in work performance is 12 per cent of the gasoline disbursed. Likewise, if the locomotive efficiency of the steam power is established at 3.5 per cent and it is determined that 14 per cent of the total coal disbursed is consumed in terminal servicing and standby loss while the locomotive is not working, the resultant fuel utilization in work performed is 3 per cent of the coal disbursed.

Calculation of the coal-gasoline equivalent from these established values would logically follow the same form as that referring to fuel-oil burned in locomotive fireboxes and the formula proposed by your committee would appear as follows:

B.t.u. per ton of coal × coal utilization percentage ÷ B.t.u. per gallon of gasoline × gasoline utilization percentage = coal equivalent in gallons per net ton of coal.

Example: 25,000,000 B.t.u. × 0.03 ÷ 125,000 × 0.12 = 50 **gallons per net ton.**

The two percentages used in the example above may be combined into a single quantity, 0.03 ÷ 0.12 = 0.25, which may be considered the "utilization factor of coal relative to gasoline." A range in such a factor from 0.40 to 0.15 would embrace a range in fuel utilization in work performed of from 10 per cent to 14 per cent for gasoline locomotives and from 2 per cent to 4 per cent for steam locomotives.

To illustrate the probable limits of consistent coal equivalent values for gasoline, gallons per net ton, the following tabulation has been prepared for coals of 13,500 to 11,500 B.t.u. per pound and gasoline of 125,000 to 130,000 B.t.u. per gallon.

Gasoline-Coal Equivalent—Gallons Per Ner Ton

Coal, B.t.u. per lb. and per ton	Gasoline, B.t.u. per gallon	Gallons per net ton			
13,500 per lb.	125,000	86	65	54	32
27,000,000 per ton	130,000	83	62	52	31
12,500 per lb.	125,000	80	60	50	40
25,000,000 per ton	130,000	77	58	48	29
11,500 per lb.	125,000	74	55	46	27.6
23,000,000 per ton	130,000	71	53	44	26.6
Utilization factors of coal relative to gasoline		0.40	0.30	0.25	0.15

Diesel Fuel Equivalent to One Net Ton of Coal

The committee proposes the same procedure for the determination of the Diesel fuel-coal equivalent that is recommended for the gasoline-coal equivalent. In this case a range in the utilization factor of coal relative to Diesel oil from 0.25 to 0.10 would embrace a range in fuel utilization in work performed of from 16 per cent to 20 per cent for Diesel locomotives and from 2 per cent to 4 per cent for steam locomotives.

To illustrate the probable limits of consistent coal equivalent values for Diesel oil, gallons per net ton, the following tabulation has been prepared for coals of 13,500 B.t.u. to 11,500 B.t.u. per pound and Diesel oil of 135,000 to 145,000 B.t.u. per gallon.

Diesel Oil-Coal Equivalent—Gallons Per Net Ton

Coal, B.t.u. per lb. and per ton	Diesel oil, B.t.u. per gallon	Gallons per net ton			
13,500 per lb. 27,000,000 per ton	135,000	50	40	30	20
	140,000	48	38.5	29	19
	145,000	46.5	37	28	18.5
12,500 per lb. 25,000,000 per ton	135,000	46	37	28	18.5
	140,000	44.5	36	27	18
	145,000	43	34.5	26	17
11,500 per lb. 23,000,000 per ton	135,000	42.5	34	26	17
	140,000	41	33	25	16.5
	145,000	40	32	24	16
Utilization factors of coal relative to Diesel oil		0.25	0.20	0.15	0.10

Conclusion

It is readily apparent that the proposals advanced by your committee do not represent any wide departure from conventional methods and it seems probable that many roads are now following the procedure fairly closely in working out their coal equivalents, since the values reported by many are of the same general order as the averages of the values tabulated in preceding sections of this report. As to other roads that are reporting the simple ratios between the B.t.u. content of coals and other fuels, it does not seem to be unreasonable to anticipate that they would each be willing, in the interest of uniformity of practice, to give serious consideration to the adoption of the suggested modified method that we are convinced will produce equivalents that are more consistent with the actual comparative performances that are commonly observed in operating practice.

There probably are isolated cases on many railroads in which, due to unusual conditions, extreme values of coal equivalents may actually apply, but it is not considered likely that such cases could be sufficiently extensive to have an important or controlling influence on the average for a railroad as a whole. It would be consistent to give due weight to each such special case in calculating the coal equivalent for each class of fuel or power for a railroad as a whole.

The report of the Committee on Fuel Records and Statistics was signed by E. E. Ramey (chairman), fuel engineer, B. & O.; P. E. Buettell, fuel supervisor, C. M. St. P. & P.; J. G. Crawford, fuel engineer, C. B. & Q.; H. Morris, superintendent fuel and locomotive performance, C. of N. J.; E. G. Sanders, fuel conservation engineer, A. T. & S. F.; W. R. Sugg, superintendent fuel conservation and lubrication, Mo. Pac., and R. J. Tucker, assistant to fuel supervisor, C. & O.

Discussion

John R. Jackson (Mo. Pac.) said that, reviewing the entire subject of fuel equivalents, it would seem that the rapid change now taking place in the situation warrants an entire reconsideration of the method of reporting fuel consumption. This is the result of the growth in the use of liquid fuel. Why not, he said, change the entire approach to the subject and report fuels in terms of the units actually used; that is, in terms of gallons of Diesel oil, in gallons of motor-car gas, etc. He suggested that the committee study the proposal that each type of fuel or energy be reported separately with a view of recommending its adoption. On motion, this suggestion was adopted.

Effect of Steam Distribution on Locomotive Performance

By J. L. Ryan

Mechanical Engineer, St. Louis-San Francisco

The statement has been made by an American authority on locomotive steam distribution systems that there is probably no subject pertaining to locomotives on which there exists wider difference of opinion than the arrangement of the details of the valves and valve gears that control steam distribution. This statement will be substantiated by an examination of the table that lists representative locomotives of recent construction.

Today far greater attention is given to the ton-mile-hour capacity of a locomotive than to its rated maximum tractive force. Mountain type locomotives having 10,000 lb. lower maximum tractive force rating than heavy Mikados on the same division are in many instances doing the better job of the two in handling fast freight runs. With the exception of where heavy ruling grades are encountered and of such length that they are not velocity grades, the horsepower rating has superseded the maximum tractive force rating. Under these operating conditions steam distribution is far more important than it was in the days of drags for freight and relatively low speed for passenger service.

Examples of Valve Data for Locomotives of Recent Construction

Type of loco.	Dia. of drivers, in.	Steam pres., lb. per sq. in.	Cyl. dia. in.	Dia. valves, in.	Valve travel, in.	Max. c.-o., per cent	Steam lap, in.	Lead, in.	Exh. clearance, in.
4-4-4	80	300	17¼	9	6½	84	1⅛	¼	¼
4-4-2	84	300	19	10	6½	84	1⅛	¼	¼
4-6-4	80	300	22	11	7½	84.5	1 5/16	5/16	⅛
4-6-4	79	275	22½	14	8½	82	1⅝	¼	3/16
4-6-4	84	300	23½	13	7	86.6	1⅛	5/16	⅛
4-6-4	84	300	23½	12	7½	84	1 5/16	5/16	¼
4-6-4	84	300	25	14	7¾	72.6	1⅞	3/16	⅛
4-8-4	80	300	25	12	7	80.8	1⅜	5/16	⅛
4-8-4	75	275	25½	14	7	87.5	1⅛	¼	¼
4-8-4	74	285	26	14	7½	86.6	1¼	¼	¼
4-8-4	80	280	26	12	7¼	73.5	1¾	¼	3/16
4-8-2	72	250	27	12	7	80	1 7/16	3/32	7/16
4-8-4	73½	250	27	12	7¼	73.5	1¾	¼	..
4-8-4	74	250	28	14	8	78.5	1¾	7/32	⅛
2-10-4	69	260	29	14	9	80	1 5/16	5/16	0
4-8-2	70	250	27	14	7¾	77.5	1¾	3/16	0
2-10-4	70	310	27	14	7½	85.0	1 5/16	¼	⅛

Two examples are given of locomotives having 1¼-in. steam lap and wide steam lap, detailing the valve events, travel, port openings and port areas for approximately 25 per cent and 50 per cent cutoffs with percentages resulting from application of wide steam lap. Example I gives the results when increasing the steam lap from 1¼ in. to 1 11/16 in., the lead unchanged, the valve travel reduced ¼ in. Example II gives the results when increasing the steam lap from 1¼ in. to 1 15/16 in., the lead and valve travel unchanged.

Representative steam areas from the boiler to the steam chests for locomotives having valves as in Examples I and II are:

	Sq. in.
Dry pipe	67.2
Superheater header, inlet	70.88
Superheater units	70.0
Throttle	70.8
Superheater header connections, each	50.2
Branch pipes, each	50.2

Referring to the two examples, it will be noted that with 1¼-in. steam lap at the short cut-off the areas are 12.25 sq. in. and 10.1 sq. in., respectively, and at 50 per cent cut-off the areas are 22.3 sq. in. and 21.2 sq. in. The areas are those with maximum port opening at the particular cut-offs. One readily appreciates that the average port area for the period of admission is less than the maximum. This is shown on the valve ellipse for the 1 15/16-in. steam lap of Example II for the port opening through the various admission periods. At 25 per cent cut-off the average opening is .716 that of the maximum and at 50 per cent cut-off the average opening is .723 that of the maximum.

At diameter speed the time interval for steam admission at 25 per cent cut-off is slightly less than one-thirtieth of a second (.03 seconds); considering this and the restricted area of the admission port, it is quite understandable why one has difficulty in detecting where the steam line ends and the expansion line begins on an indicator card taken at these speeds.

This brings out rather sharply one of the inherent weaknesses of the radial gears—greatly reduced areas for the operation that has reduced time interval. That the restriction of limited port areas on the work-rate capacity may be partially removed is readily apparent from an examination of the effect of steam lap in the two examples. Without change in the lead, increasing the steam lap from 1¼ in. to 1 11/16 in., Example I, results in 19 per cent greater admission port area at 27 per cent cut-off and 32 per cent greater admission port area at 50 per cent cut-off. The exhaust port openings without change in exhaust clearance, are increased at these cut-offs respectively 30 per cent and 32 per cent. Without change in the lead, increasing the steam lap from 1¼ in. to 1 15/16 in., Example II, results in 30.7 per cent greater admission port area at 25 per cent cut-off and 50.5 per cent greater admission port area at 50 per cent cut-off. The exhaust port openings with change in the exhaust clearance are increased at these cut-offs respectively 50.7 per cent and 53.3

Example I—Effect of Wide Steam Lap—28-In. Stroke

			Per cent increase with wide steam lap
Steam lap, in.	1 1/4	1 11/16	....
Valve diameter, in.	14	14	....
Valve travel, in.	8 3/4	8 1/2	....
Maximum cut-off, per cent	89.5	80.7	....
Lead, in.	1/4	1/4	....
Exhaust clearance, in.	1/8	1/8	....
Exhaust opening at end of stroke, in.	1 5/8	2 1/16	....
Exhaust port area at end of stroke, sq. in.	55.2	70.0	26.8
Events at 27 1/2 Per Cent Cut-Off			
Release, in.	18.5	19.1	....
Closure, in.	7.41	7.47	....
Pre-admission, in.	0.66	0.40	....
Valve travel, in.	3.22	4.23	....
Admission—port opening, in.	0.36	0.43	....
Admission—port area, sq. in.	12.25	14.6	19.2
Exhaust—port opening, in.	1.73	2.25	....
Exhaust—port area, sq. in.	58.8	76.5	30.1
Events at 50 Per Cent Cut-Off			
Release, in.	22.125	22.56	....
Closure, in.	4.47	4.43	....
Pre-admission, in.	0.21	0.157	....
Valve travel, in.	3.81	5.11	....
Admission—port opening, in.	0.657	0.867	....
Admission—port area, sq. in.	22.3	29.5	32.0
Exhaust—port opening, in.	2.03	2.68	....
Exhaust—port area, sq. in.	69.0	91.1	32.0

per cent. The increase in the admission port areas and the greater freedom of the exhaust adds substantially to the capacity of a locomotive, and to its economy when considering similar work rates. The higher the operating speeds the more pronounced are the benefits that are derived.

Effect of Valve Characteristics on Steam Distribution

Steam Lap—The most important factor in steam distribution is the steam lap. It determines the travel and velocity of the valve at short cut-offs, causes expansion and pre-release, and has a decided effect on the width of admission- and exhaust-port openings. When the steam lap is extended the following desirable features are obtained: (1) wider port openings for both admission and exhaust; (2) increased valve travel for a given point of cut-off, decreased influence from lost motion; (3) increased freedom of release, resulting in a lower back pressure; (4) less pre-admission for a given lead at all points of cut-off permits using maximum lead for capacity without excessive pre-admission, and (5) higher mean effective pressure at all points of cut-off.

Lead—At the shorter cut-offs the lead vitally effects the maximum steam-port openings obtained. With narrow lap lead in excess of 1/4 in. rapidly increases the pre-admission. It is not so critical in this respect with wide lap valves.

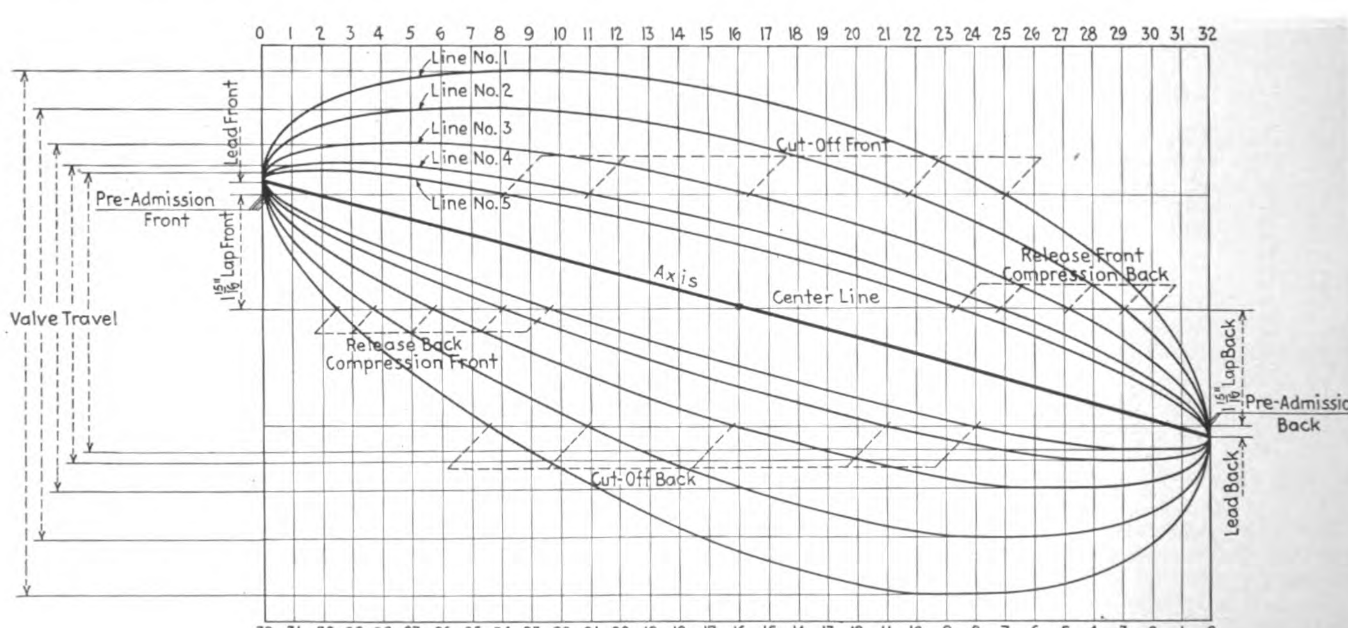
Exhaust Clearance—Exhaust clearance functions on the exhaust side of the valve in much the same manner as lead on the steam side. It not only hastens the release and retards compression, but widens out the exhaust opening. The earlier release results in a thermodynamic loss in the expansion line. With valves having narrow steam lap exhaust clearance is resorted to for exhaust freedom for the higher work rates and to reduce the compression at the shorter cut-offs. It can be dispensed with to a great extent with wide-steam-lap valves.

Long Valve Travel—An increase in maximum valve travel to that which may be termed long travel has no effect whatever on the valve action at the shorter cut-offs, it merely gives a late maximum cut-off. To affect an improvement obtaining greater horsepower capacity it is necessary to take advantage of the longer travel by increasing the steam lap.

Diameter of Valve—The areas of the admission and exhaust ports are in direct proportion to the diameter of the valve used where similar practice is followed in the application of bridges. If the power of the engine is limited at the shorter cut-offs by

Example II—Effect of Wide Steam Lap—32-In. Stroke

			Per cent increase with wide steam lap
Steam lap, in.	1 1/4	1 15/16	....
Valve diameter, in.	14	14	....
Valve travel, in.	8 3/4	8 3/4	....
Maximum cut-off, per cent	89.7	77.3	....
Lead, in.	3/16	3/16	....
Exhaust clearance, in.	0	0	....
Exhaust opening at end of stroke, in.	1 7/16	2 1/8	....
Exhaust port area at end of stroke, sq. in.	48.8	71.6	46.5
Events at 25 Per Cent Cut-Off			
Release, in.	22.44	22.87	....
Closure, in.	9.56	9.12	....
Pre-admission, in.	.453	.28	....
Valve travel, in.	3.09	4.65	....
Admission—port opening, in.	.297	.39	....
Admission—port area, sq. in.	10.1	13.2	30.7
Exhaust—port opening, in.	1.547	2.33	....
Exhaust—port area, sq. in.	52.5	79.1	50.7
Events at 50.4 Per Cent Cut-Off			
Release, in.	26.44	26.72	....
Closure, in.	5.56	5.28	....
Pre-admission, in.	.156	.094	....
Valve travel, in.	3.75	5.75	....
Admission—port opening, in.	.625	.937	....
Admission—port area, sq. in.	21.2	31.9	50.5
Exhaust—port opening, in.	1.875	2.875	....
Exhaust—port area, sq. in.	63.8	97.8	53.3



Valve ellipse for the 1 15/16-in. steam lap of Example II

these areas it is obvious that the diameter selected will have a vital influence on the performance.

Design Practices—Four-six-fours having the same general boiler pressure and driving wheel diameters will be found with steam lap from 1⅛ in. to 1⅞ in. and the lead from 3/16 in to 5/16 in. Based on the type of locomotive and driver diameter one may rightfully assume the service assignments to be quite similar. Four-eight-fours will be found with the steam lap from 1⅝ in. to 1¾ in. and the lead from 7/32 in. to 5/16 in. Locomotives of the 4-8-4 type are more susceptible to having a wider variation in their operating demands from one railway to another as one may design for high-speed heavy passenger, another for dual service, and another for high-speed freight. Locomotives of the 2-10-4 type having boiler pressures within the high-pressure range and drivers of corresponding diameter have 1 5/16-in. steam lap and 1 15/16-in. steam lap.

Suggestions for Dealing with Inertia Forces

The inertia forces in the valve gears vary to the square of the speed. It is quite understandable that, with the recent speeding up of passenger service with steam locomotives designed for diameter speed and with maintenance hardly up to the standard required for the new peak speeds, some valve-gear maintenance troubles were experienced and that to relieve such troubles a trend developed to shorten valve travel with the resultant required short steam lap. To avoid too great a restriction on capacity maximum lead was provided which introduces the objectionable operating effect of excessive pre-admission at the shorter cut-offs.

To remove to the extent reasonably possible the restrictions in the steam distribution in our locomotives at the shorter cut-offs the following procedure would be effective in the right direction: (1) valves of lightweight construction using bronze valve rings preferably of a sectional type; (2) refinement in the design of the valve gear parts, using steels having higher physical properties making an exception of the material in the eccentric rods that are subject to shop adjustment; (3) the providing of more liberal areas in the bearing comparable with the high speed service requirements. Preferably the application of roller bearings as the elimination of the play inherent in friction bearings greatly reduces the shock load on the valve gear, and (4) large diameter of eccentric-crank fit on the main pin with a key having increased proportions.

This will make practical long valve travel and steam laps not less than 1⅝ in. for high-speed passenger service and 1¾ in. to 1⅞ in. for fast heavy freight. The valve diameter should be not less than 14 in. for locomotives where reasonable high capacity is expected.

With the additional admission-port opening obtained with the wide steam lap it is usual practice to provide a lead not exceeding ¼ in. Where the operation requires the greatest possible capacity at the higher speeds an additional 1/16-in. lead would effect a distinct gain without as detrimental an effect from excessive pre-admission as when providing the same lead with short steam lap. Where the peak power demand is at the longer cut-offs and moderate speeds, advantage may be taken of the increased admission-port opening obtained with wide steam lap to reduce the lead to approximately 3/16 in. and exceptionally smooth operation be obtained at short cut-off.

More Power from Old Locomotives

We should not concentrate our efforts on the few new locomotives to the exclusion of the many older locomotives that will be continued in service for a number of years. With the railways taking an ever increasing load from week to week, those of us in the motive power departments should carefully analyze possible sources of power increase.

Where increase in the tractive force or horsepower of existing locomotives is desirable, if the boiler stresses permit, it is common practice to raise the working pressure. This also increases the stresses in frames, crank pins, rods, etc., and in some instances the latter stresses are increased beyond acceptable limits so that the pressure cannot be raised.

There is another source of power increase for operation at speeds above that of starting that is just as tangible in producing operating results as is increased boiler pressure, but that unfortunately appears not to be fully appreciated by many. It is the increase that may be effected in the mean effective pressure at given cut-offs and piston speeds of many of our locomotives without change in boiler pressure. This is brought about by providing more liberal steam admission and exhaust areas for the various cut-offs as previously outlined. Of major consideration is the fact that the boiler stresses and the running-gear stresses from maximum piston thrust are not affected. Some increase should be expected in the maintenance of such items as packing, rod bearings, driving box bearings, etc.

What Expenditure Is Justified?

New Diesel locomotives are costing $80 to $85 per rated horsepower. New steam locomotives for road service are costing are costing $30 to $35 per horsepower, rating the locomotives on the maximum that may be reasonably developed, not on Coles rating.

Assuming a service life expectancy of 25 years for the new steam locomotives, the initial investment is $1.30 per horsepower per year of service-life. Applying this to an improvement to be made in an existing locomotive that has 10 years service expectancy remaining, and assuming that the improvement will increase the capacity of the locomotive 350 hp., the permitted investment would be $1.30 × 10 × 350 = $4,550.

In the majority of instances the changes in the valve gears and related steam-distribution parts that would be required to give approximate maximum results within the range here considered would come within cost bounds of $700 to $2,000. Present design and proportions would necessarily govern the extent to which changes of parts would be required and the increase in horsepower capacity that would result. It is quite possible by changes in the steam distribution systems to add 300 to 700 hp. to the capacity of locomotives that were not carefully designed for maximum power.

Discussion

P. D. Hawkins (Erie) spoke of the so-called compression knock due to the sudden change in the sign of the force at the end of the stroke and the clearances in the rod bearings. Apparently insignificant changes in preadmission port area, he said, have effected very significant changes in locomotive operation at high-speed and short cut-off.

The Steam That Does No Work

By Lawrence Richardson

Assistant to Vice-President and General Manager, Boston & Maine

The best test of any business or manufacturing activity is its efficiency at light load or no load. Almost any company can make money if business is good and orders call for a night shift. Only if it can operate efficiently when the orders get scarce and hours are shortened will it hope to successfully weather business storms. Likewise, heavy traffic will keep some railroads going which, when the curve turns down, are handed to the sheriff.

The real test of efficient locomotive operation is the overall efficiency. Good efficiency while working may be more than offset by poor efficiency while drifting. But on hilly roads, which are the rule rather than the exception, so much fuel is used downhill that a high drifting efficiency is necessary in order to obtain a satisfactory overall efficiency. There are many divisions in this country where 20 per cent or more of the total coal is used in drifting. A halving of the fuel used in drifting will decrease the fuel consumption 10 per cent on such divisions. There are records of divisions where this economy has actually been effected. There are many others where there are similar potential savings.

Smoke Lifting

Why use steam downhill? The principal, and in certain cases the only reason, is to lift smoke. No crew can satisfactorily operate a locomotive with smoke rolling in their eyes. Improvements in front end design—freer nozzles and enlarged stacks—have only added to the problem. But equally as important are the passengers. High-speed trains produce eddy currents proportional to the square of the speed. A train at 70 m. p. h. has twice as much suction effect as a train at 50 m. p. h. The result has been that some of the mile-a-minute trains have had smoke drawn into the air-conditioning system with consequent annoyance to passengers. In fact, some western roads have solved their difficulties by projecting the stack more than 16 ft. above the rail. But only a few roads can do that. Certainly no eastern road can do so with restricted clearances established years ago when power was light and cars small.

The alternative remedy is to design the locomotive properly to minimize the roll of the smoke. Do not misunderstand this statement to mean streamlining. In fact, some streamline locomotives have been guilty of annoying smoke infiltration in the air conditioning system.

There are two cardinal principles to be followed. First, get the smoke up as high as possible. Second, do not have eddy currents to pull it down again. Both problems so far have been largely attacked by cut-and-try methods. The results are largely a matter of individual opinions, always difficult to reconcile, rather than fact. The scientific use of wind tunnels and smoke streams to solve this problem is yet to be done. Nevertheless, the fund of information already collected in the development of modern aviation is helpful.

The second principle is to prevent eddy currents. What good is it to get smoke up and then have eddy currents pull it down again? Here again, the knowledge of airplane design is helpful. Whenever possible, projections should be avoided or streamlined. They should be placed outside the smoke stream area where possible. Changes in dimension should be as smooth as possible. There is also a device which is helpful where there is a tendency to produce eddy currents, a tendency that cannot be completely eliminated. It is the use of vertical plane surfaces to knife through eddy current areas and produce streamline currents. They are sometimes referred to as wings. Successful use has been made of these thin wings in France, Germany and the United States. A recent test on one of our largest railroads has shown them to be the most effective device in keeping smoke from rolling downward.

The better the front-end design, the less steam required in the blower. A poorly designed front end may require a full opening of the blower valve while a well designed front end will only call for cracking of the valve. The difference has an appreciable effect on the coal consumption.

Keeping Valves and Cylinders Lubricated

The other use of steam downhill, (when used), is to aid lubrication and prevent damage to the valves and cylinders. A few roads use by-pass valves, but the majority use steam. Where by-pass valves are used, they must be correctly designed and of ample capacity or they are useless. The German railways use a large by-pass, some 8 in. in diameter. One of the principal western lines in this country also uses the same device. When this by-pass is large, there is practically no compression as the air is free to move back and forth from one end of the cylinder to the other. The lack of compression under certain conditions is a disadvantage, especially if the reciprocating parts need effective cushioning at the end of the stroke. This generally occurs when drifting at speed.

In one design the relief and by-pass features are combined in one valve. In this device, the valve opens when the pressure in the steam chest drops to atmospheric pressure. This move opens ports to the atmosphere to serve as relief ports and also opens passages between the steam chest and exhaust passages serving as a by-pass. Care in shutting the throttle is of assistance in the operation of this valve.

Relief valves have practically disappeared from modern locomotive practice. Hardly a locomotive built in the last twenty years has had them applied. When used, the valves fluttered quite a bit and often failed. Carbonization frequently occurred. These failures contributed in a large measure to their discard.

The large majority of American railroads drift with steam. Those that just let an engine drift without special valves or without using a drifting valve or cracked throttle either do not have long drifts or else are having troubles that they should not have. A test was being run on our road one day and the engineer failed to open the drifting valve. The minute the train crowned the summit and starting drifting, the temperature started rising, reaching a maximum of 825 deg. No oil will stand that temperature. There had been indications of this condition in that the paint had cracked off the valve chamber. After this temperature had been discovered, it was quietly confirmed by an engineman who told of seeing a valve chamber red hot. The explanation is simple. The work done in compressing air must be dissipated as heat. [Mr. Richardson presented a table showing final temperatures for various final pressures of compression. This showed that, starting with air at 60 deg. F., a final air pressure of 250 lb. raised the temperature to 749 deg. F.]

If this compression starts just after shutting off steam, when the cylinder is hot, you end up with air at a much higher temperature. With such temperatures possible, is it any wonder that we find carbon deposits in cylinders? The best of oil will burn under these conditions. My personal feeling is that the bulk of carbon found in valves and cylinders comes from this cause and that rarely, if ever, does it come from sucking in smokebox gas through the exhaust passages. Smokebox gases rarely exceed 600 deg. F. and, when drifting, are appreciably lower.

The use of steam in drifting thus becomes a question of economy. It is entirely possible and practicable to drift with a cracked throttle. The chief drawback to the use of a cracked throttle is the trouble of maintaining a small opening and the difficulty of knowing just how much steam is flowing. A back pressure gage indicates the latter. A throttle 14 in. in diameter cracked 1/16 in. has a steam opening of 5½ sq. in. Tests on one of our Pacifics show that 0.44 sq. in. is sufficient. The comparison is obvious. In plain English, 5 sq. in. out of the 5½ is admitting "steam that does no work."

Some roads use a 2-in. globe valve for drifting to get better control. This gives up to 3 sq. in. of steam opening. There is a feeling on the part of some that it is necessary to prevent any vacuum in the cylinder. The difficulty in accomplishing this lies in the high pressure needed at the start of the stroke. With 7 per cent clearance, 210 lb. is needed. With 10 per cent clearance, 147 lb. It is more economical to work with lower pressures and have a slight vacuum at the end of the stroke, but not enough to bring gas all the way from the smokebox. To minimize this possibility the two exhaust passages should be designed to meet as near the valve as practicable, so that one end can help to break the vacuum in the other end and prevent sucking smokebox gas back into the valve.

The matter of valve and cylinder lubrication while drifting is of paramount importance. Not as much oil is required for drifting as is required for working. But some oil is required. Only a small amount of steam is needed to carry sufficient lubrication to the wearing surfaces.

In general, our experience shows that the proper drifting of locomotives effects appreciable economies in fuel. The amount of "steam that does no work" must be kept to a minimum in order to obtain a low number of lb. of coal for 1,000 gross ton miles.

Much work has been done along these lines. Much more needs to be done. There is no field of locomotive operation that offers the research possibilities that drifting does. The difficulty in the past has been that while locomotive testing plants permitted careful study of the locomotive, they do not work in reverse. They will not drift. When the throttle is shut on a test plant, the speed will drop from 30 m. p. h. to 0 in as short a time as one second. There is practically no drift in such a case.

However, foreign railroads have worked out a method of testing in road service whereby the locomotive is dragged by another locomotive. This permits of scientific study that is so necessary if the drifting of locomotives is to be done scientifically. The Diesel presents no drifting problem. The steam locomotive does. If steam is to keep abreast of Diesels, much research remains to be done.

Discussion

F. P. Roesch (Standard Stoker Co.) recalled some tests which were made during the days of the United States Railroad Administration during the last war on the effect of gases of various

temperatures on lubricating oil. With an oil of 550 deg. flash test, he said, relief valves which admitted air to the cylinders were bad where the temperature of the steam was over 600 deg. The carbonization in cylinders, ports, and valve chambers is not altogether from smoke, he said, but more from the oil itself.

In these tests, he said, it was found that, if the pressure in the steam chests was reduced below 45 deg. F., some vacuum developed in the cylinders, which sucked back air and some smokebox gases. The test developed that a 2-in. pipe would supply sufficient saturated steam to the steam chest to maintain the 45 lb. pressure. After two or three miles of drifting the cylinders would cool down sufficiently, he said, so that the drifting throttle could be closed without danger to the oil.

Mr. Roesch commented on the fact that stacks are constantly growing larger in diameter and suggested that smoke lifting might be improved by making them narrower and deeper along the longitudinal center line of the locomotive, thus reducing the wind resistance and the tendency toward eddy currents behind the stack.

R. M. Ostermann (The Superheater Co.) said that the smoke-lifting function of the steam used in drifting can be effected in other ways, but that the function of protecting the lubrication offers greater difficulties. He asked Mr. Richardson how he would dissipate the heat of friction without the use of steam in drifting.

E. E. Chapman (A. T. & S. F.) told of smoke-lifting tests on the Santa Fe in which a vacuum was found immediately back of the stack. He said that the problem was solved on the high-speed locomotives by the development of an extension stack.

In closing, Mr. Richardson agreed with Mr. Roesch that there is a vacuum in the cylinder at the end of the stroke, but that this is partially broken by pressure in the exhaust at the other end of the cylinder without drawing gases back through the exhaust nozzle. To facilitate this he suggested that the junction of the exhaust passages from the two ends of the cylinders should be as close to the cylinder as possible.

In commenting on Mr. Ostermann's question with respect to the energy which must be dissipated in drifting, he said one test had shown the drag while drifting to be over 400 hp. He also agrees with Mr. Roesch that the present design of stack is incorrect; it should be shaped to reduce air resistance and the vacuum behind the stack.

Report on the Utilization of Locomotives

The Administration at Washington is very much concerned about the possibility that the railroads may not be able to handle all traffic offered, and the Association of American Railroads, Ralph Budd, and other officers have repeatedly called to our attention, that it may be necessary to handle up to 25 per cent more business. We know we can handle our present business. It may work out that the railroads as a whole are not required to handle such an increase. But in certain territories, that increase may be presented, so it would seem that consideration should be given as to whether it is possible to obtain 25 per cent more use of our present locomotive plant, and what means are required to obtain that use.

In the table are shown six-month comparisons of the average mileages of active locomotives per day. These show the following increase in the last five years: Passenger, 13.7 per cent; freight, 9.0 per cent, and switch, 51.9 per cent.

On this basis, considering that passenger trains average 50 m.p.h. and freight trains 25 m.p.h., and, of course, switch engines 6 m.p.h., it can readily be calculated that on all of the roads in the country, the passenger and freight engines are working 4 to 5 hours a day, and the switch engines, 13 hours.

The July, 1941, reports from the 13 largest railroad systems indicate that the following mileages were made by the locomotives on the top two roads and the next four roads in the service indicated.

	Passenger	Freight	Switch
The two roads obtaining the most miles per active locomotive day	300	145	90
The next group of four roads	240	125	84
All roads in the United States	196	117	78

Taking the performance of the two roads that obtain the most miles per day during July, we find the passenger and freight engines working six to seven hours, and the switch engines working fifteen hours. That is, these roads have obtained in road service over 40 per cent more use, and in switch service 15 per cent more use than the average, and when I tell you that the Santa Fe and Union Pacific are the roads obtaining the best mileage in passenger and freight service, you will recall that these roads have, in many instances, been the pioneers in developing long, through locomotive runs.

Going back to the figures for all of the roads, 196 miles in passenger service, indicates a run over two short divisions and the 117 miles in freight service, a run over one division per locomotive per day. It would seem that, even taking the average of all of the engines, it would be possible by close coordination to obtain more than this mileage.

What 25 Per Cent More Locomotives Would Cost

There are, roughly, 34,000 active locomotives in passenger, freight and switch service. It would require the purchase of about 8,500 locomotives to handle 25 per cent more business. Figuring conservatively, at this time, they would cost about $160,000 apiece, which amounts to $1,370,000,000. That is only the locomotives themselves. It would require shops, facilities, etc., to take care of this tremendously increased number of units, because monthly, quarterly and annual inspections are based on the number of units, rather than the mileage obtained per unit. This, of course, is impossible.

Methods of Increasing Miles Per Day of Active Locomotives

The report of the committee last year included the following items:

"Steam switchers have been run 30 days without ever being off the job.

"Passenger engines will make 20,000 miles a month.

"It requires less gray matter to get high mileage out of electric, Diesel, or oil-fired steam locomotives than it does from coal-fired locomotives."

Through Run

A study should be made of each yard operation, to see how many freight trains run through the yard promptly; i.e., go through the yard in approximately an hour. On those trains, the engines should be run through. Then, a study should be made of the rest of the trains arriving and leaving the yard to see if it is possible to match them up so that the departing train will use

Comparison of Miles per Active Locomotive Day for First Six Months

Districts	1941	1940	1939	1938	1937	1936
	Miles per active locomotive day					
Passenger						
Eastern	188.4	184.9	179.3	175.4	174.2	167.0
Pocahontas	180.0	165.8	172.4	155.9	158.6	158.0
Southern	180.9	171.7	162.0	160.2	162.5	158.0
Western	216.9	207.8	199.3	190.3	198.2	189.9
Total (U. S.)	197.1	190.3	183.5	177.7	180.6	173.3
Freight						
Eastern	114.2	109.4	105.5	101.0	108.7	107.2
Pocahontas	96.4	94.0	85.8	82.6	96.3	90.6
Southern	110.5	99.1	96.2	89.5	99.4	97.1
Western	116.6	107.4	103.4	99.1	112.8	106.2
Total (U. S.)	113.7	106.0	102.1	97.3	108.2	104.3
Switch						
Eastern	82.2	76.2	72.6	67.8	60.2	53.4
Pocahontas	73.2	73.2	66.6	64.2	63.6	58.8
Southern	60.0	57.0	54.6	52.2	48.6	43.2
Western	72.6	67.2	63.0	61.2	52.8	46.2
Total (U. S.)	75.6	70.2	66.6	63.0	56.4	49.8

the engine from a train that has arrived within an hour or an hour and a half.

Then a study should be made and all of a type of power through the enginehouse should be charted carefully to see if the enginehouse foreman "sells out" at least once a day; that is, if he uses everything in the house at least once during the 24 hours. This, of course, does not include the locomotives held for repairs taking 24 hours or over and should possibly, except a protection engine, which he can call on in case some of his regular engines fall down.

It will be found, in general, that it is possible, with the through runs, to put engines back in service after perhaps 30 min. at the enginehouse whereas, if they follow the regular course of coming in on one train and going out on another, it will be found that the turning time may average around five hours.

All of these arrangements having been made just as far as is consistent with good practice, a study should be made of the other runs, to see if it is possible to get the engine from the yard to the enginehouse more promptly, or if it is possible to call the engine closer to the departing time of the train, so as to eliminate as much as possible of the yard delay.

This scheme, worked out at various terminals, has been widely praised by enginehouse foremen because they say that previously when five or six trains are approaching, they had to scurry around and get five or six engines ready, and now they can wait until the first engine arrives, then put the gang on her, and promptly put her back to work; then, when the next engine comes, they work on her. It is much simpler, they say, than producing a half-dozen engines, and then having five or six laying around the house for some time, until you can get them back to work.

The superintendent, of course, will co-operate and will, with his trainmasters and yardmasters, assist in lining up those matched runs.

The next study should be the type of power, because frequently it is found that a lighter engine is held for a light job, and while the light engine is being used, there are some of the heavier engines laying at the enginehouse because of the spacing of trains. In the last analysis, this heavy engine could be used for the light job, and make it possible to eliminate entirely this particular lighter engine.

There frequently is a difference of opinion as to whether the enginehouse actually sells out once during the 24 hours; that is, uses everything but their reserve engines, and that matter can be easily demonstrated—doesn't require any argument—because if the engines, so far as possible, will be used last in, first out, any surplus power will automatically be passed by, and will, by its continued presence in the enginehouse, demonstrate that it is a surplus.

Coal

Many times it is necessary to replace an engine on the train because the arriving engine doesn't have enough coal to go through and the coaling facilities are so far away that the engine can't be returned to the train in time to make the present fast schedules. In that case, it is suggested that a small coaler be placed at a convenient location in the yard, so that when the engine comes with a train, it can be coaled while still coupled to the train. These small coalers have been costing under $1,000, and it will perhaps cost another $1,000 or so to arrange the coaling tracks, so that a complete installation of a coaler that will put on a ton a minute should not run much over $3,000. That, surely, doesn't represent much investment compared to $170,000 for a locomotive.

If it is thought that the ton a minute is too slow, the same type of equipment can be obtained, that will put on two tons a minute, or two of these coalers can be set up in parallel with a slight increase in cost.

Water

Water in large quantities, of course, is essential, and again it is generally cheaper to put a water plug at a convenient place in the yard than to lose the services of an essential locomotive. The total cost of the facility, of course, will depend on how many locomotive hours can be saved.

If we have, say, five runs and can save five hours per locomotive, this is a total of twenty-five hours a day. In other words, we are saving about one locomotive. The saving is not only the first cost of the locomotive but the cost of at least $200 a month that it requires to keep an extra unit in service.

Maintenance

With through running engines, the local roundhouse foreman no longer has a general knowledge of their condition and, therefore, he many times feels reluctant to mark an engine out for a definite time until after its arrival and complete inspection. It is necessary to develop some general supervision over the engines, which will provide adequate maintenance at regular intervals, emphasizing that this is not necessary every 150 miles, but that it is essential at certain periods if long, through runs are going to be practical. This requires a competent inspection organization, and well seasoned foremen, who, from long experience, will know the essential work that is required on a locomotive and who have made a study of the period at which this work should be performed. This should be handled through an organization that is in touch with the entire territory, so that this work can be done after the locomotive has performed a certain amount of service and that records of that performance will be returned to the maintaining enginehouse for their information and guidance.

Reports indicate that to support active locomotives on the road it will require about nine per cent more locomotives which will be found in the enginehouses undergoing periodic repairs. Many times this percentage creeps up but capable supervision can keep it down as low as nine per cent.

Summary

What are we doing? Keeping the machine working about 20 per cent of the time.

What should we do? Keep the road machine working at least 25 per cent of the time. This seems a first class way of showing that the railroads are capable of doing all of the work that the people of the United States require, and that they are capable of doing it promptly and effectively.

It will save the expenditure of tremendous sums of money for the purchase of new equipment, if that were possible, and it will save, also, very substantial sums in maintenance. Finally, it would seem that all that is required to do efficiently the job which the railroad men believe can be done, is the expenditure of a little gray matter in clearly thinking through the details of the problem of the use of locomotives.

The report was signed by A. A. Raymond (chairman), superintendent, fuel and locomotive performance, New York Central: H. W. Bates, assistant master mechanic, C. M. St. P. & P.; E. J. Cyr, master mechanic, C. B. & Q.; E. W. Erisman, general road foreman of engines, Wabash; S. L. Forney, road foreman of engines, M-K-T; O. R. Pendy, general roundhouse foreman, N. Y. C. & St. L.; W. E. Sample, assistant chief of motive power and equipment, B. & O.; and E. G. Sanders, fuel engineer, A. T. & S. F.

Discussion

J. M. Nicholson (A. T. & S. F.) said that a big part of recent business increases have been handled through the more intensive utilization of the motive power already in service. Their freight-locomotive performance in July, 1941, he said, was 27 miles per locomotive per day better than during July, 1940. With a little pressure, he said, a lot more can be done.

W. R. Sugg (Mo. Pac.) called attention to the fact that the increase in the miles per locomotive per day has been accounted for by the increase in speed of freight trains; there has been no improvement in the number of active hours per freight locomotive day.

L. E. Dix (T. & P.) told of some of the difficulties of railroad operation in Louisiana where a large contingent of the U. S. Army has been on field manoeuvers. Where trains are captured and held, he said, not much can be done to increase locomotive-miles per day.

A trainmaster on the New York Central emphasized the importance of giving the mechanical department full information on train movements in advance in order that locomotives can be run through. He said that he did not like to let a locomotive go to the enginehouse at all.

H. W. Sefton (C. C. C. & St. L.) called attention to the misuse of power represented in such operations as keeping the locomotive out of the terminal for one or two hours longer than

should be necessary in order to move a handful of cars from one yard to another.

H. B. Springer (B. & A.) cited as evidence of waste locomotive time the calling of the locomotive and waiting until it has arrived at the train before charging the air brakes from a yard plant available for that purpose. Another way of wasting locomotive time, he said, was requiring all trains to stop for set-outs and pick-ups over the division, instead of confining such service to a pick-up train. He also questioned the need of air-brake tests every 100 miles.

Mr. Springer said that the real job of improving locomotive utilization is one on which all departments should get together in each territory and work out means for eliminating the local causes of delays.

Force Feed Lubrication

Because of more dependable and accurate feeding of oil against pressure, and also because of easier control of the quantity used, force-feed or mechanical lubrication of valves, cylinders and steam auxiliaries has almost entirely replaced hydrostatic lubrication on modern locomotives. The setting of mechanical lubricators to deliver the proper amount of oil to each outlet requires care and study.

Setting Mechanical Lubricator Feeds for Valves and Cylinders

One method proven successful in practice is as follows: By trial and observation on the road, feeds are adjusted to each delivery point so as to provide the minimum oil necessary for proper lubrication. It must be realized that all other conditions being equal, increased average speed requires an increased amount of valve oil, likewise other conditions being equal, an increased average load requires an increased amount of valve oil.

After feeds have been set to provide proper lubrication for one locomotive of each class, the lubricator is then removed from the locomotive, connected on a test rack, which is then operated at a speed corresponding to not higher than the average speed in the class of service in which the locomotive is used, for the number of revolutions equivalent to a twenty-mile run, and the output of oil from each feed measured in a glass cup graduated in liquid ounces. This information is then used as a guide in setting lubricators on other locomotives of the same class.

An important feature of setting lubricators on test racks is the speed of lubricator drive. Most makes of mechanical lubricators increase in pumping efficiency with an increase in speed, therefore if the test rack is operated and feeds set for a sufficient output of oil at this high speed, when the lubricator is applied to the locomotive, the output of oil may be insufficient at low speed.

The practice of setting lubricators on test racks is as follows: First, having performed the necessary mechanical work and cleaned the lubricator, the mechanic operating the test rack connects the lubricator on the test rack, then refers to instructions to determine the number of revolutions of lubricator drive shaft equivalent to a 20-mile run with the locomotive, then refers to a table to determine the number of ounces of oil to be delivered from each feed.

Each feed of the lubricator discharges into a large-mouth glass cup, graduated in liquid ounces. With experience, it is possible to set the lubricator feeds so that it is rarely necessary to make more than two runs with the lubricator before getting feeds set properly.

Under this procedure, it is not necessary to consider the efficiency of each individual lubricator pump, except to be assured that each feed will deliver an excess over that required. In other words, a given lubricator pump may deliver four ounces of oil at given speed, temperature, and number of pump strokes for a given setting of adjusting screw, and another less efficient pump may only deliver three ounces under the same conditions. So long as the less efficient pump will deliver more than enough oil, inefficiency is compensated for by increasing the stroke of the pump.

If the pump efficiency falls below the necessary margin of capacity for valves, it is changed to the cylinder position, then to air pump or stoker position, and finally to a non-pressure position in the machinery lubricator.

Terminal checks of test rack should be set in accordance with manufacturer's instructions.

In order properly to control the use of oil in mechanical lubricators, it is essential that these lubricators be equipped with sight glasses and gages easily read from a position close to the lubricator.

It is recommended that of the total quantity of valve oil fed to a valve and cylinder, from 60 per cent to 75 per cent be fed to the valve, and from 40 per cent to 25 per cent to the cylinder. All excess oil fed to the valve will pass into the cylinder, but excess oil fed to the cylinder will be carried out by the exhaust and wasted.

A second method for determining the oil allowance for valve oil lubricators is also included in this report. As will be noted, this covers both mechanical and hydrostatic lubricators.

Another Method

In the following tables are data for use in setting the feeds of mechanical lubricators for valves and cylinders which were developed after study and experiment. In practice they are said to have reduced wear in cylinders, valves and accessories on locomotives under average normal conditions.

Data for Setting Lubricator Feeds

Type locomotive	Boiler pressure	Rev. of drivers per mile	Cut off, per cent	Miles per hour	Drops per mile per 100 sq. in. per valve and cyl. surface
YARD MINE RUN AND SHORT TRANSFER SERVICE					
Simple engine.....	165-210	350-400	Full	6	1.50
Compound mallets..	180-200	320-360	Full	6	2.50
Compound mallets..	205-225	320-360	Full	6	3.00
Compound mallets..	230-265	320-360	Full	6	3.50
Simple mallets:					
Back eng.	200-215	320-360	Full	6	2.50
Front eng.	200-215	320-360	Full	6	2.50
Simple mallets:					
Back eng.	225-270	320-360	Full	6	3.50
Front eng.	225-270	320-360	Full	6	3.50
LOCOMOTIVES IN THROUGH FREIGHT SERVICE					
Simple	180-200	320	50	20	1.85
Simple	210-225	320	50	20	2.50
Simple (note)	230-270	320	50	20	3.00
Simple mallets:					
Back eng.	200-220	320	50	20	3.50
Front eng.	200-220	320	50	20	3.50
Simple mallets:					
Back eng.	225-270	320	50	20	4.50
Front eng.	225-270	320	50	20	4.50
Compound mallets (lubricate through back eng.)	180-200	320	50	20	3.00
Compound mallets (lubricate through back eng.)	205-225	320	50	20	3.50
Compound mallets (lubricate through back eng.)	230-265	320	50	20	4.00
Compound mallets:					
Back eng.	180-200	320	50	20	2.00
Front eng.	180-200	320	50	20	1.50
Compound mallets:					
Back eng.	205-225	320	50	20	2.50
Front eng.	205-225	320	50	20	1.50
Compound mallets:					
Back eng.	230-265	320	50	20	3.00
Front eng.	230-265	320	50	20	2.00
LOCOMOTIVES IN PASSENGER SERVICE					
Simple	160-180	275	50	30	1.85
Simple	185-200	275	50	30	2.25
Simple	210-240	275	50	30	2.75
Simple	240-270	275	50	30	3.50

Oil Requirements of Accessories

TIME BASIS, DROPS PER MINUTE

	Yard service, 6 m.p.h., drops	Freight service. 20 m.p.h., drops	Passenger service, 30 m.p.h., drops	Local pass. service, 25 m.p.h., drops
Air pumps	2 to 3	4 to 5	3 to 4	4 to 5
Stoker	1	5 to 6	4 to 5	5 to 6
Feedwater pump	1	5 to 6	5 to 6	5 to 6
Intercepting valve	1 every 3 min.	1 every 5 min.	.....	.....
Drifting valve	Local frt., 1	1 every 10 min.	1 every 5 min.	1
Booster	.....	½ idling to 10 in service	½ idling to 10 in service	½ idling to 10 in service

MECHANICAL LUBRICATOR, DROPS PER MILE

	Yard	Freight	Passenger	Local pass.
Air pumps	20 to 22	12 to 14	6 to 8	8 to 10
Stoker	6 to 8	15 to 17	9 to 10	10 to 12
Feedwater pump	8 to 10	15 to 18	10 to 12	10 to 12
Each guide feed	6 to 8	8 to 10	8 to 10	8 to 9
Each eng. or t'l'r truck	......	5 to 6	5 to 6	5 to 6
Each boiler bearing	2 to 4	3 to 4	......	......
Drifting valve	......	1	1	2 to 3
Intercepting valve	3	1	......	......

Forced Feed Lubrication of Machinery

Dependable automatic or mechanical lubrication of locomotive machinery is one of the most important factors in long engine runs and intensive utilization of power. In past years this lack of dependable lubrication restricted the length of non-stop engine runs, and to a great extent limited locomotive mileage per day or month.

The wider application of roller bearings has greatly increased the availability of power, but the availability of the conventional bearing locomotive is also greatly increased by automatic machinery lubrication.

On some roads, feeds from the valve-oil lubricator are piped to the most important machinery bearings, such as guides, but on many roads, one or more mechanical lubricators are used for machinery lubrication only. Where separate mechanical lubricators are used for oiling the machinery, a grade of oil most suitable and economical for the purpose can be used.

Oil dividers or splitters have been perfected to the point that various combinations of feeds may be used. By using combinations of dividers, it is possible to lubricate all parts of the machinery desired, using a mechanical lubricator with a comparatively small number of feeds, dividing each feed to as many outlets as may be required.

With proper application of force feed lubrication to such points on the conventional-bearing locomotive as guides, link blocks, engine-truck, driver and trailer hubs, shoes and wedges, and on the roller-bearing locomotive to guides, link blocks, engine-truck, driver, trailer pedestals and flange faces of roller bearing driver housings, together with soft pressure grease lubrication of valve-gear bearings, it is possible to run long distances with little or no difficulty, by filling the lubricators as required at points most convenient. Other bearings such as furnace bearers, radius-bar lifter bearings, and such other points as may be desired can also be mechanically lubricated.

The piping arrangement should be such as to permit of passing a steam pipe from a point at the lubricator along with the oil piping as far as may be necessary to prevent the oil from becoming too cold in winter. One economical way to do this is to use a heater pipe into the heating cavity of the lubricator, and from the lubricator along and wrapped with the oil piping.

The report was signed by W. R. Sugg (Chairman), superintendent conservation of fuel and lubrication, Missouri Pacific; J. R. Brooks, supervisor lubrication and supplies, C. & O.; P. C. Withrow, assistant to chief mechanical officer, D. & R. G. W.; D. C. Davis, supervisor lubrication, A. T. & S. F.; L. M. Griffith, lubrication engineer, Southern Pacific, and J. W. Hergenhan, assistant engineer, test department, N. Y. C.

Discussion

H. W. Sefton (C. C. C. & St. L.) expressed the opinion that with properly lubricated shoes and wedges it should be possible to save from 25 to 50 per cent of rod-maintenance work. When not effectively lubricated, he said, wedges are left loose to prevent sticking, thus throwing additional loads on the rod bearings.

Mr. Wink (A. C. L.), referring to the modern lubricator test rack which that road has installed at the Waycross shops, said that it had been found that, where two feeds come out from a single pump connection on a mechanical lubricator, more oil is delivered from the top connection than from the bottom connection. The effect of the difference, he said, becomes large when the feed is cut down.

The Atlantic Coast Line, he said, had gone into the lubrication of valve-gear bearings. He cited the case of a locomotive which makes 10,000 miles per month for four months on a regular assignment and then is moved around until the same season next year. He said, except for the renewal of one bushing, no valve-gear bearings have given any trouble on this locomotive for two years.

Utilizing Coal of Various Sizes

In giving consideration to the best utilization of the various sizes of coal we must first consider at least two major sources of supply. When the chief source of supply is from company-owned mines, the problem of proper distribution is entirely different than when the coal is purchased on the open market. Let us then first consider the best disposition of coal when the mines are company-owned and from which there can be no sale of any undesirable sizes.

Distribution Problems with Company-Owned Mines

Run-of-mine coal is, of course, the most easily prepared and the cheapest to handle, but is not the best preparation for the various types of locomotives or the various classes of service. In order to get the best possible use from the fuel, some segregation is very desirable.

For the various hand-fired locomotives which are becoming scarcer year by year, a 1¼-in. by 3-in. or possibly a 2-in. by 4-in. egg is the most economical size both for firing economy and for the elimination of objectionable smoke. It is worth considerable effort to bring about segregation to reach this objective, allowing the smaller sizes to go to stoker locomotives and locomotives of larger grate area and fire-box capacity.

During the cold weather the demand for power-house screenings reduces the amount of the smaller sizes that must be consumed in locomotives, but this situation is reversed during the warm weather. At this time every effort should be made to confine the use of screenings to territories where the best possible utilization may be obtained.

Coal From Commercial Mines

Where the supply is obtained from the various mines independently operated as commercial properties, the problem of size utilization becomes somewhat more difficult to regulate because the railroad is expected to serve as a sort of a buffer between the consuming public and the coal producers, making a constantly changing picture. During the warm weather the power- and heating-plant consumption is at its lowest ebb, and during this time many mines ask for relief because of a surplus of screenings. If the pleas of the operators are to be met, there is only one thing to do: remix the screenings with the various sizes of egg and lump coal in order to produce a better mixture and a better locomotive fuel than if screenings were used entirely as such.

During certain times of the year, lump coal becomes a drug on the market and again the railroad company is asked to relieve the situation. In order to protect our stoker equipment, as well as give a better preparation for stoker locomotives, it then becomes expedient to order this coal billed to one of the coal tipples equipped with a mechanical crusher or grizzly bars of proper spacing so the coal can be reduced to an approximately zero by 4-in. size. This causes some extra switching, but the railroad obtains a better fuel by such maneuvering. Sometimes the slump

in the domestic market for lump coal occurs at such a time that some of this coal can well be utilized for station use where lump coal is generally regarded as superior to egg or the smaller sizes for use in the various stoves and furnaces.

When the storage of coal is attempted, the larger sizes are more desirable, as this coal not only stores more safely from a viewpoint of combustion hazards, but also makes a better locomotive fuel after having been in storage for a considerable length of time than would the smaller sizes. It is the accepted practice on many railroads to store nothing smaller than 1¼-in. by 4-in., the preference being 4-in. by 6-in., 6-in. by 8 in. or 8-in. lump.

Segregating Coal Sizes at Various Tipples

On railroads that operate under both of the above mentioned plans, we find that the results obtained by utilizing the various sizes at the various coal tipples are very satisfactory. At the company-owned mines it has been found expedient to install a crusher that reduces the top size to 8-in. This creates some additional fines, but the disadvantage is more than offset by the reduced cost of handling at the various coal tipples and the elimination of switching, especially for clam-shell operation where run-of-mine coal cannot possibly be used satisfactorily.

From an economical standpoint, fuel used by railroads is normally obtained from coal fields at or near the immediate vicinity through which the particular railroad operates. For this reason practically every variety of coal available is used for locomotive fuel. With the more modern railroad coal-handling facilities, where the various kinds and sizes of coal required on the different types of locomotives can be segregated, more economical results can be obtained in the consumption of fuel.

Another factor of no small importance is to make provision to prevent the segregation of various sizes of coal after it is delivered to the bin from which the locomotive tender is loaded. Without this provision, one locomotive tender is supplied with egg or nut coal and the next tender is supplied with an exceptionally large percentage of screenings coal. Obviously under these circumstances the most desirable coal cannot be delivered to the locomotive in each instance.

Best Coal Sizes for Stoker Locomotives

From actual tests conducted in through freight and passenger service, on stoker-fired locomotives, the best results are obtained with coal as placed in the locomotive tender ranging from ¼-in. by 2¾-in. in size. On the hand-fired locomotives better results are obtained when using nut or small egg coal ranging from 2-in. by 4-in. in size.

It has been determined under test that coal larger than 3-in. top size does not distribute properly in fire boxes with grate areas of 80 or more sq. ft. If the fireman adjusts steam jets to distribute the larger size coal over the entire grate surface, the smaller sizes will be carried up against the throat sheet. If steam jets are adjusted to permit smaller sizes from carying over against the throat sheet, the larger sizes will fall short around the distributor or fire pot, resulting in an uneven fuel bed and poor combustion results.

Owing to many railroads using all of the various sized coal on both stoker- and hand-fired locomotives it is felt that the stoker designers have a special duty to perform before delivering new stokers to the railroads. That is to have their engineers make a survey of the coal which is to be handled by the stokers. The conveyor screw mechanism should be of such design that the diameter and the pitch of the conveyor screw will handle the normal run-of-mine coal up to 8-in. lump from shopping to shopping without difficulty.

The tendency on the part of some stoker designers is to furnish a general type of screw conveyor mechanism to handle all grades of coal whether prepared or run-of-mine. This procedure is satisfactory on railroads that prepare the coal or whose coal does not exceed 4-in. top size, but when a railroad contracts for coal up to 8-in. lump or prepares its coal not to exceed 8-in. in size, the stoker designers should take this into consideration and build stokers to suit that size of coal.

With the ever-increasing size of locomotives now being built for use on the American railroads, the majority being equipped with stokers for coal burning, the question of coal utilization of the various sizes is demanding consideration. Where the smaller sizes of coal are available at a price lower than run-of-mine or modified run-of-mine, it would be profitable to make tests of the various sizes compiling your records on a cost basis as well as a consumption basis.

Test Results Favorable to High Proportion of Screenings

A railroad whose entire operation is in mountainous territory has been using the small sizes of coal since 1926 and has each year increased the percentage of small sizes used until in the year 1940, 60 per cent of the total coal used on locomotives was 1⅝-in. by zero, 1½-in. by zero, 1¼-in. by zero, and 1-in. by zero coal. Had the same size coal been used in 1939 as in 1933 at the increased price paid for the coal in 1939, the cost would have increased approximately $16,145.

Better train load, good locomotives correctly drafted, with good grates fitted with precision and properly handled and fired, and a larger per cent of stokers in use were the factors largely responsible for the successful firing of the smaller sizes of coal.

This committee recommends the use of coal not to exceed 2¾-in. in size for stoker-fired locomotives and ranging in size between 2¾-in. and zero. For hand-fired locomotives the size of coal should not exceed 4 in. This recommendation is based on good clean coal which means that the best of cleaning preparations are required at the mines.

It is equally important that the proper fuel sizing and cleaning be considered for stationary power plant furnaces for economical operating purposes. The proper sized coal for stationary power plant furnaces is dependent upon the type of firing appurtenance that is installed in the plant.

The report was signed by S. A. Dickson, chairman, fuel supervisor, Alton; M. B. Adamson, fuel inspector, C. R. I. & P.; P. E. Buettell, fuel supervisor, C. M. St. P. & P.; W. T. Capps, stoker supervisor, B. & O.; J. D. Clark, fuel supervisor, C. & O.; H. B. Grimshaw, fuel supervisor, S. A. L.; S. M. Roth, road foreman of engines, Western Maryland; and W. J. Tapp, superintendent of fuel conservation, D. & R. G. W.

Discussion

In presenting the report Mr. Dixon called attention to a supplement, the data for which were received too late to be included with the advance copies of the report. This supplement was the report of the tests run at the request of the New York Central and participated in by the Pittsburgh Coal Company and Standard Stoker Company. The object was to determine the extent to which coal is broken down in going through the stoker. Tests were made at delivery rates of 7,000 and 13,000 lb. per hr. each with several sizes of coal.

W. R. Sugg (Mo. Pac.) was in agreement with the report on the value of using small sizes of coal not exceeding 2 in. or 3 in., but called attention to the operator's problem of disposing of the large size coal. He took issue with the committee that 2-in. by 4-in. egg coal is the most economical size on hand-fired locomotives. It is all right, he said, so far as operation on the road is concerned, but in terminals the fire can not be properly banked and it is more difficult to keep the locomotive from smoking.

W. J. Tapp (D. & R. G. W.) reiterated the statement in the report based on the experience of the D. & R. G. W. that the smaller sizes of coal are the most economical. He said that, with the increase in the amount of 1⅝-in. by 0 coal used on that railroad, there had been no steam failures and both the cost and the consumption had been steadily reduced.

Frank P. Roesch (Standard Stoker Co.) said that the stoker has to deliver the maximum amount of coal required and must handle any size delivered to the tender. The stoker screws, he said, are adjusted to handle sizes up to 8 in. If made to handle larger sizes, he said, then the delivery rate would be too great at the minimum engine speed. One of the difficulties which had formerly been encountered in the operation of the stoker crew was the boiling out of lumps at the front of the trough in the tender. This, he said, had been corrected. Mr. Roesch said that he was not an advocate of large coal sizes. Stack loss, he said, is caused by vertical air openings in the grates.

J. D. Clark (C. & O.) believes that the sizing of coal for the stoker is important and that it should be done before the coal is placed on the tender. He considers it important to have coal of a sufficiently uniform size so that it will not be broken down by crushing in the stoker. The C. & O., he said, has been using 2¾-in. nut.

G. M. Boh (Erie) inquired of the chairman how coal with

a considerable percentage of fines can be delivered to the locomotive without segregation as the coal drops from the bin into the tender.

Mr. Dixon, in replying to Mr. Sugg's question, suggested that tests should be made to determine precisely what size is needed for use under terminal conditions. He pointed out that two coals of the same analysis may be quite different in their performance, one being smoky and the other relatively free from smoke. This, he said, is a case of the difference in the volatile constituents. One reason, he said, for using larger sizes and not adhering to the small sizes is the high percentage of impurities in the fine coal. To avoid segregation of coal when delivered to the tender, Mr. Dixon said that he had obtained the best results by dropping the coal straight down into the bins. When this is done the lump coal rolls to the sides and, then, when the coal is dropped into the tender, the lumps roll back in again and mix in proper proportions with the fines in the center of the bin. He emphasized the importance of getting rid of large air openings in the grate and of employing something along the line of the Tuyere type grate.

Fuel Economy from the Viewpoint of the Water Engineer

By R. C. Bardwell

Superintendent Water Supply, The Chesapeake & Ohio

At least four problems must be solved in the satisfactory handling of water for locomotive boilers; namely, (1) the prevention of scale, (2) corrosion, (3) foaming, and (4) embrittlement. Experience has shown that the best results can be obtained by giving individual consideration to the practical requirements of the individual supplies rather than to rely on promiscuous dosing of the boilers at the terminals. This has broadened the work of the water engineer to the extent of developing accurate treating plant or proportioning equipment as well as the handling of the application of specific reagents to prevent certain boiler troubles and checking the actual condition of the water in the boilers at terminals to improve operation.

The advancement in the chemical treatment of boiler feedwater for locomotives has been such that the expense and trouble formerly caused by scale and corrosion can be practically eliminated or very materially reduced at nominal cost by the application of the methods which have been repeatedly demonstrated as being suitable for the various conditions. Fortunately, the most practical treatment for preventing the formation of hard and destructive scale deposits, has also been found to be the most effective means for reducing corrosion and pitting. As early as 1912, W. A. Pownall outlined before the Western Railway Club that hard scale can be eliminated by adding soda ash, caustic soda, or equivalent chemicals in sufficient amount to maintain an excess alkalinity over the hardness in the actual boiler water of at least 15 per cent of the total dissolved solids. These conditions can be checked by simple, reliable standardized tests.

The Value of Excess Alkalinity

Because of lack of space and limited clearances on a locomotive, it is not possible to install deaerating feedwater heaters to remove oxygen which is the principal cause of corrosion and pitting. Check by the American Railway Engineering Association Water Committee reported in 1925, indicated that maintenance of an excess alkalinity of 15 per cent would normally restrict the activity of the oxygen and materially reduce pitting and corrosion. With some waters, a higher excess alkalinity is required, even up to 30 per cent of the dissolved solids as reported to the Master Boilermakers Association by Seniff in 1939 for correcting conditions on the Alton. I have personally found it good practice to maintain the excess alkalinity between a minimum of 20 and a maximum of 30 per cent which has materially improved boiler conditions on the Chesapeake & Ohio, the Nickel Plate, and the Pere Marquette.

The treatment of the water may be handled by any one of several different methods, each of which has its advantages and disadvantages. Properly operated lime and soda-ash plants will deliver a clear, soft water with the mud, sediment and organic matter also removed before delivery for use. Soda ash or the wayside method where chemicals are added direct to the storage tanks in amounts sufficient to neutralize the hard scale with no sedimentation, has shown good results at low first cost where competent and careful supervision is provided. Zeolite plants with a clear supply will deliver zero hardness water but trouble has been reported from pitting and corrosion. "Interior" treatment using soda ash or proprietary compounds for direct application to boilers at terminals have improved conditions when followed up under a well supervised plan for checking the treatment in conjunction with a suitable blowoff schedule which will prevent excess accumulation of solids precipitated in the boilers, but this practice appears to be losing favor because of more consistent results obtained where the individual waters are given attention at the wayside stations in accordance with their particular requirements.

Blowdowns

One of the biggest steps in the improvement of locomotive boiler conditions and fuel economy, took place with the realization and effect of proper blowdowns. The advantages were fully outlined in a report to your 1927 meeting by a committee of which W. A. Pownall was chairman, but the acceptance of the idea seemed to be unusually slow by most railroads. This is rather surprising on account of the similarity of conditions when using coal for firing. The lack of understanding was probably due to the fact that the fire-bed can be seen and visibly examined while until the comparatively recent development of practical rapid means for checking the dissolved solids in a boiler water sample at the roundhouse, it was not possible for the terminal forces to know the actual boiler water conditions and whether it was proper to expect continued good operation.

All coal contains more or less impurities. When the pure coal goes off as heat and gases, the impurities are left behind as ashes and clinkers. The occasional shaking of grates to remove the ashes and impurities is taken as matter of course.

However, conditions on the other side of the fire sheets are fully as important. All waters contain impurities of various kinds in the form of scaling matter, alkali salts, or sludge. When the pure water goes out as steam, these impurities remain and concentrate in the boiler. When this concentration of impurities reaches a critical point, the water becomes sticky or "light" and the steam bubbles do not break readily and release the steam but build up on the surface of the water to such an extent that the bubble films and entrained water are carried to the cylinders with the steam and the engine is reported as foaming. It would seem logical that the proper thing to do is to "shake the grates" on the water side of the fire sheets by opening the blow-off cock sufficiently often to remove enough of the impurities and dirty water and replace it with fresh water to prevent this critical concentration from being reached or exceeded.

When proper supervision is being given to water treatment and the satisfactory operation of the water in the boiler, these critical concentration points are determined for the different classes of power over their respective districts. With this information available and knowledge of the water quality and the amount consumed, it is possible to outline blowdown procedures which will replace sufficient dirty water with a fresh supply and prevent the critical concentration from being exceeded. Where this is followed, foaming is eliminated. This practice will permit the continuous operation of the boiler for the full 30-day allowable periods between washouts and the boiler is kept reasonably clean throughout its service.

To operate with the extended washout period, competent supervision and check is as necessary as for any other type of work. It is necessary to know that the blowoff system is in good condition and will work. Then it is necessary to know that the water in the boiler is being maintained in good condition. A good practice is to have water samples taken from each boiler entering and leaving the terminal and tested to determine the concentration upon arrival. This will disclose the attention given

to blowing by the previous road crew, and will permit lowering the concentration sufficiently before leaving to insure a successful ensuing trip. There are now devices on the market at reasonable price and sufficiently accurate which can be used by the regular roundhouse force with a little instruction and occasional check, to make these determinations and give the terminal authorities the same information regarding conditions on the water side of the fire sheets as they have been accustomed to expect of the conditions on the fire side.

With the modern mufflers now available, blowing can be handled satisfactorily at most any location. Devices are on the market which provide for automatic operation of both continuous and intermittent blowdown but most railroads still rely on the intermittent use of the large blowoff cock at designated points or at times which are left to the discretion of the engine crews. One large company has a device which is in the nature of a foam collecting trough which is connected to a blowoff cock that opens automatically whenever the trough becomes filled with water. It is possible that further developments will be made along the line of improving the conditions for handling continuous blows, as results to date, indicate that this is a worth while factor in promoting economical operation of steam locomotives.

Caustic Embrittlement

The other problem in conditioning water for locomotive use is one which has come up within the past 30 years and is connected with the formation of cracks radiating out from rivet holes in highly stressed areas where slight leaks have permitted the high concentration of boiler water solids against the stressed metal. This trouble is only partially due to water conditions but research at the Bureau of Mines which has been financed partly by contributions from the Association of American Railroads, indicates that the trouble can be relieved, to some extent at least, by special treatment of the water supplies which may enter into the trouble at particular locations. Small devices have been designated by the Bureau of Mines laboratory which can be readily applied to a locomotive fire box and will show inside of 30 days if the water is of an embrittling nature.

It has been repeatedly demonstrated that proper water treatment will result in a considerable improvement in boiler conditions which are directly connected with fuel economy. The term, "proper water treatment" means the continuous check of water quality both before and during boiler operation in order to insure that desired conditions are being maintained regularly. Good results by the haphazard, occasional application of chemicals, regardless of type, can only be an accident. If railroads are not in a position to handle their own water treatment with a company water chemist, it is possible to contract this work with one of several commercial companies who are organized and equipped to handle the laboratory tests and the field inspection with the necessary competent check supervision. It is necessary that this competent check supervision be provided, either by company force or by contract, if consistent, good results are to be obtained. It is further necessary that full cooperation between the water chemists and the road and shop forces be carried on at all times.

Discussion

J. R. Jackson (Mo. Pac.) spoke of the tremendous improvement in boiler conditions during the past 25 years and pointed out the possibilities for further economies in the future. He cited the effectiveness of the foam control system in use in the boilers of some of the locomotives on the Missouri Pacific. That road, he said, had been following the practice of blowing down on the road since 1933, with a great improvement in boiler conditions, although there is some question as to its effect on fuel economy. He said that experimental work was under way on the Missouri Pacific to effect a chemical solution of the foaming problem. This, he said, would, if successful, pay large dividends in fuel economy. The blow-down in some cases takes as much as 25 per cent of the water fed to the boiler.

In closing, Mr. Bardwell said that at present there is no economical means to effect the results sought by Mr. Jackson. Research is continuing, he said.

Referring to the waste of fuel in blowing-down, he said that this is not the same as blowing the same weight of water out through the pops, since the water which passes through the blow-off cock has not yet been evaporated and so has not taken up the latent heat of evaporation. Three pounds of water can be blown through the blow-off cocks, he said, with no more heat lost than in one pound of steam blown through the pops.

Car Officers' Annual Meeting

(Continued from Page 409)

The pioneering and presentation of streamliner equipment with its numerous luxuries, modern accommodations and fast operating schedules has met with public favor and consequently we as mechanical supervisors had an obligation to meet in maintaining this equipment in the most exacting manner with respect to safe and on time operation, appearance, repairs and cleanliness. We believe you will agree that critical observations of our equipment will definitely indicate that this procedure of specializing in maintenance work is reflected in the present condition of streamliner trains operating throughout the country today.

The report was presented by Chairman C. P. Nelson, general foreman, C. & N. W.

Discussion

C. T. Ripley, chief engineer, Technical board, Wrought Steel Wheel Industry, said that many wheels are removed unnecessarily from the trucks of high-speed trains because of complaints of hard riding which should not be charged to the wheels. He indicated that slightly worn wheels are often removed for this cause when, in all probability the rough riding was due to some mechanical truck condition or to some out-of-round wheel.

Mr. Swanson said that railroads generally are now changing more wheels than ever before and it is quite a problem for coach yard foremen to know what to do, especially when complaints of rough riding come from people not experienced enough to differentiate between either minor or severe cases of rough riding and, of course, totally unable to help determine the cause. One member said that passengers frequently complain about one car in a train and say nothing about another which is a far "worse rider."

Mr. Swanson also called attention to the increased severity of wheel service on modern high-speed trains and said that on the Milwaukee, some trains have as many as 250 brake applications for curves, turnout and station stops in a distance of 200 miles. He said that the car wheel grinding machine recently installed at Western Avenue (Chicago), has permitted reducing wheel changes on high-speed passenger trains 75 per cent.

(The report was accepted.)

* * *

Photo by W. Curtis Montz

On the Lehigh Valley at Falls, Pa.

L. M. O. A. Considers Personnel and Repair Problems

Two-day meeting at Chicago attracted 113 members who devoted entire time to the presentation and discussion of technical committee reports—New officers elected

THE problems involved in the selection and training of apprentices and several phases of locomotive maintenance work occupied the 113 members of the Locomotive Maintenance Officers' Association during the two-day meeting of the 1941 convention at the Hotel Sherman, Chicago, September 23 and 24. Following a joint session of the Co-ordinated Associations, which was addressed by V. R. Hawthorne, executive vice-chairman, A. A. R. Mechanical Division the first technical session was called to order by President J. C. Miller, general foreman, New York, Chicago & St. Louis.

In his opening address Mr. Miller summarized briefly the events leading up to this years meeting and said further, in part:

"There is a real need in organizations such as ours for painstaking study and investigation which can best be accomplished by committees made up of men from various sections of the country who work under a wide variety of conditions. The gathering and assembling of material in a report is in itself a challenge to the thinking and better performance of those who take part in the project, and when the report is finally discussed by the association and disseminated it is a practical and substantial contribution to the entire membership.

"It is not an easy task to perform successful committee work. Techniques must be developed, unless men are available who have had considerable experience in working on committees for other organizations. Unfortunately, the "lean thirties" deprived most of our members of such experiences. We have a lot to learn in this respect. We may have deliberately to seek for men as new members who can be helpful in this way. If we are alert and open-minded and seriously study how to make our committee work more effective we can overcome the handicap; other related associations have done so and we will do well to study their methods of handling committee work.

"The reports presented at this meeting are the Association's first contribution in the form of committee work. It is not necessary for me to point out that these reports are not a 100 per cent job—they couldn't be, for even Association committees with years of experience do not do a perfect job. These reports are, however, the foundation of something that can be built into an invaluable structure in the years to come. They represent the medium through which data on the variety of practices involved in repairing locomotives can be co-ordinated and presented to the industry in a manner that the industry can use it to advantage. There is no better way in which the ideas of practical men can be brought together and made available to all.

"Regardless of what the future may bring the railroad industry is going to be faced with many problems that are not going to be easy to solve and it is my earnest hope that this Association may continue to show its fitness to be accorded a place among those who will be charged with the responsibility of offering the solution."

The committee reports presented were on the following subjects: Methods for aligning frames, wheels and boxes; apprenticeship; inspection and maintenance of mechanical lubricators; description and operation of HSC air-brake equipment, and a survey of the use of high-speed and carbide tool steels in locomotive machining operations.

In the first-mentioned report the committee presented the details of a suggested method for assuring the positive alignment of the running-gear members of a steam locomotive while undergoing repairs in the back shop and a method by which locomotives can be checked to determine whether or not wheels, bearings and frame are in line as they should be. This report, with drawings, will appear in a subsequent issue. The air brake report presented by J. P. Stewart, (chairman) general air brake supervisor, Missouri Pacific was designed to acquaint the men who will be called on to maintain HSC brake equipment with the equipment itself and the manner in which it functions.

Report on Apprenticeship

In the decade preceding our entry into the first World War, apprenticeship methods on a few railroad systems were so far advanced that they attracted the attention of leaders in industry. Men like George M. Basford, who at the turn of the century and for several years thereafter was editor of the publication now known as the *Railway Mechanical Engineer*, and who was a veritable crusader in the interests of better training; Charles W. Cross and W. P. Russell of the New York Central; and Frank W. Thomas of the Santa Fe, were in great demand at meetings of experts in the field of industrial training. The Canadian railways also maintained the same high standard of thoroughness in apprentice training as had been characteristic of the British railways.

The proceedings of the American Railway Master Mechanics' Association and the pages of the *Railway Mechanical Engineer* and its predecessor, the American Engineer and Railroad Journal, clearly reflect the splendid progress that was being made in improving training practices in the early part of the century. Apprentice training methods on the railroads of North America, in general, were well advanced until economic conditions in the 30's knocked them into a cocked hat, except in a few places, and even there they were slowed down almost to a standstill.

D. S. Ellis,
Chief Mechanical Officer,
Chesapeake & Ohio

O. A. Garber,
Chief Mechanical Officer,
Missouri Pacific Lines

J. Roberts,
Chief of Motive Power and Car
Equipment, Canadian National

Advisory Board Members

G. C. Christy,
General Superintendent of
Equipment, Illinois Central

J. C. Miller,
President

D. J. Sheehan,
Superintendent Motive Power,
Chicago & Eastern Illinois

J. E. Goodwin,
First Vice-Pres. and Sec.-Treas.

F. J. Topping,
Second Vice-President

S. O. Rentschler,
Third Vice-President

As the position of the railways began to improve in recent years, steps were taken to build up the apprentice quotas and to start restoring the training methods and practices to their former degree of efficiency and effectiveness.

Even though the railroads have been unable to return to the elaborate methods and programs followed by some of them in the 20's, the more essential elements have been retained in most shops, because many of the supervisors of today were trained under those systems in the two decades extending from 1910 to the 30's. Realizing what modern apprenticeship methods meant to them, they are today doing their share in passing on these benefits to the present generation of apprentices. Moreover, it may be remarked in passing that with the trail well blazed, adequate training methods may be promoted today on a less expensive basis than in the days when the art was in the early stages of development.

Increased business, due to the second World War and our own national defense program, brought us face to face quite some time ago with the necessity for taking prompt and aggressive measures to recruit and train young men to fill the depleted ranks of skilled workers. Moreover, improvements in the design and construction of railway equipment, the greater stress under which it is operated, and the necessity for higher standards of maintenance and the working to closer tolerances demand still higher standards of craftsmanship.

The Purpose of This Report

It is not the purpose of this report to attempt to cover apprentice training methods in any great detail. A. H. Williams, general supervisor of apprentice training of the Canadian National Railways, did a splendid job in this respect in a paper which he presented before our association two years ago. Our committee has confined its studies largely to what it considers to be the more vital aspects of the problem that seem to demand special consideration at this time.

Nor, on the other hand, has the committee considered any emergency measures to supply semi-trained workers or "specialists" for "the duration." If that does become necessary on the railroads it may be best to co-operate with other local organizations that have pioneered in this respect and have been carrying on intensive training measures in various parts of the country, in some instances for many months.

The railroad equipment maintenance forces are already beginning to suffer from the inroads on their skilled forces by other industries, and also because of the effect of the selective service draft. Mechanics trained in the locomotive repair shop in the past three decades have been in demand by industry in times of economic prosperity or under war conditions, because the all-around training received in the railroad shops has developed much better mechanics than those trained in the more highly specialized manufacturing plants. In the case of the selective service draft, judging by the experience of some few railroads, the draft board when called upon to do so have not hesitated to put skilled railroad workers in the deferred classifications.

What Are We Striving For?

In a broad way, what is the aim or objective of the railroad mechanical department in its apprentice training program? It can best be expressed in a few words and in a simple and terse way. *It is to insure an ample supply, but not a surplus, of capable, well-trained mechanics in each of the several crafts employed in the locomotive shops.* From this group, over the years, a certain percentage of men having leadership capabilities will be advanced to supervisory positions, at which time they will require additional special training; this, while important, is incidental to the apprentice training program.

Essential Factors of Apprentice Training

What factors must be given consideration to insure the proper training of well rounded-out mechanics?

(a) Obviously the basis of such training is thorough experience and training in the shop, on the various jobs and types of work involved in the particular trade.

(b) The apprentice must receive some related training in mathematics and blue print reading. He should also be given information as to the parts which go to make up a locomotive and how they function, as well as other technical data related to his craft.

(c) In order to develop the young men to their greatest capabilities, certain outside or extra curricula activities should be encouraged.

How Many Apprentices?

Labor union agreements with the railroads indicate a considerable variety in the allowable percentage of apprentices to mechanics. There can be no question but that it is to the advantage of both the labor unions and the railroad managements to insure a sufficient number of graduate apprentices, so that there may be no shortage in skilled labor.

The exact percentage allowable has been the cause of much discussion and there have been strong differences of opinion because of the difficulty in establishing any formula which would take all of the various factors into consideration to insure a steady supply of new skilled workers to meet changing conditions or to take the place of those who drop out of the service for one reason or another. Naturally the most troublesome problem has been to allow for business cycles. That, however, is not peculiar to the railroads.

It is unfortunate that at the very time when more apprentices should be added at the depth of a business depression to take care of the business revival following, it has not seemed feasible or advisable to make such additions. On the other hand, at the peak of prosperity the tendency has been to increase the number of apprentices, which sometimes results in having the largest numbers of lads completing their time when employment conditions may be at their very worst. It is doubtful if any way can be found to remedy this situation, except to make greater and greater efforts to stabilize employment and to dampen the swings in the business cycle. That is beyond the power of the railroads to control, but American leaders (not politicians) are seeking to find ways of solving this baffling problem, and undoubtedly will make progress in the days to come.

It is worthy of note, however, that some railroads in recent years have made great progress in stabilizing employment among their equipment maintenance forces.

Your committee has been greatly impressed with the policy that has been followed for several years by the Canadian National Railways with a view to more or less accurately and scientifically determining the number of apprentices that should be added in each trade throughout each particular year. In other words, the attempt has been made to train only that number of apprentices that can be retained in the service of the railroad at the completion of their apprenticeship and to provide for the normal separations from service each year. To do this, accurate records have been compiled and careful surveys are made periodically.

Workers on that system are retired at a specified age and it is, of course, not a difficult task to determine how many of the men at present employed will reach the retirement age in any given year. Statistics are also kept up-to-date as to the rate at which craftsmen are separated from the payrolls because of deaths, resignations, dismissals, promotions to supervisory positions which remove them from the craftsmen's payroll, etc. Except for unusual contingencies or business cycles, it is possible in this way to make a fairly close approximation of the number of new men that must be added in any one craft in any one year, for a number of years to come. Allowance must, of course, also be made for the number of apprentices who start, but who are eliminated during the probationary period, or fall out for various reasons before they are graduated.

There are, however, certain other factors that must be taken into consideration if a high standard of training is to be maintained. It is a mistake to add too many apprentices at one time. They should be inducted into service continuously, the rate of induction being so controlled that the training will proceed in an orderly manner and in such a way as to insure that each apprentice is moved regularly from one class of work to another and is given a thorough training. If the attempt is made to add too many apprentices at one time, the routine may become clogged up and the individual apprentice may not receive adequate instruction.

The Problem of Selection

Too much attention cannot be given to the proper selection of apprentices to insure as high a quality of skill and craftsmanship as possible. From the standpoint of morale, both managements and the labor unions feel that a very considerable per-

centage of the apprentices should come from the families of employees. Many of the labor union agreements require this. It should, however, not be allowed to interfere with selecting men who are well qualified for the particular kind of work for which the selection is made. A lad ought not to be employed just because he needs a job or is the son of an employee, regardless of whether he is suited to the work or not. If this is done it is an injustice to the boy, and works out to the disadvantage of both the labor unions and the employer.

The age limits in some of the agreements are too low. State laws and the fact that the standards of preparatory education have advanced, in general, over the years, would seem to make it advisable not to take into the service young men under the age of 18, and the top age might well be extended to as high as 23, or even above.

Railroads in recent years have found no difficulty in getting all of the young men they need with high school or vocational school diplomas. The young men are required, of course, to pass physical examinations, and more and more roads are giving intelligence and aptitude tests. While it is true that judgment must be used in applying such tests, there seems to be little question but what they are helpful in making it possible to check on the selection of young men of the right calibre.

It has been found good practice, also, in examining and checking up the young men, to consult their high school and vocational teachers and instructors. It is not enough to have the scholastic records of the young men. Their personalities and habits should be inquired into and this can best be done by talking about them informally with the high school and vocational school authorities.

More than this, however, it has been suggested that the railroads should not wait for the young men to come to them, but rather should go to the high schools and vocational schools to find the men who are specially suited for particular jobs on the railroads, and urge them to enter the railroad service. As one authority suggested, "If we want the best material we must seek it out."

Probationary Period

There has possibly been too much laxity in some places in making close and critical check-ups during the probationary period. The young men are hired in the expectancy that they will spend a lifetime in the service of the railroad. If it is found they are not well fitted for the work or adapted to it, they should be eliminated during the probationary period. It must be admitted that as more and more attention is given to the careful and critical selection of the young men in the first place, there is less and less possibility of having to drop them out during the probationary period.

One tendency that should be guarded against has been noted in a few instances. Some of the young men take particular pains to make a good showing during the first six months of their employment and then when they have passed the probationary period, may be inclined to slow up or slack down. Men of this type, of course, are not desirable; this simply emphasizes the fact that character and disposition must be taken into careful consideration in making the selections in the first place.

Shop Instruction

Close adherence should be given to the routing or scheduling of the apprentices during their entire courses. They should spend the specified time on every machine and on every phase of work included in the program for their particular trade. It is to be feared that unless special precautions are taken, the shop authorities, in the interest of production, may not make the shifts on schedule and the young men may suffer thereby. This is only one of several good reasons why there should be shop instructors at each important point, not only to check up and see that the apprentice is given the proper instruction and coaching in the shop work, but that he is routed according to schedule.

As an interesting sidelight, the presidents of the apprentice clubs on one system make checks, as officers of the clubs, and bring to the attention of the shop authorities any deviation from the schedules.

There is little question, also, but what the schedules for apprentice training in the locomotive shops should be reviewed occasionally and possibly be readjusted. Some schedules, for instance, do not ordinarily give the boys experience on the erecting side of the shop until well along in their apprenticeship. There are some who believe this to be a serious error. It is advisable, as quickly as possible, for the apprentice to understand how the various parts of the locomotive function and how they are put together. If, early in the game, and possibly 60 days after he starts in his apprenticeship, he can be assigned to the erecting side for a period of six months, he will secure this information and can do a much more intelligent job when he handles a particular part on the machine side.

One apprentice supervisor makes a practice of having the apprentices in groups visit the greased test track when locomotives just out of the shop are checked and broken in. They watch the locomotive pass by with the drivers revolving at high speed. Then, one by one, they are permitted to ride on the locomotive. To a lad they are astonished at the extent of the vibrations, and inquire as to whether the locomotive jolts and vibrates as much in actual service—which it does if it is badly out of balance, which defect is, of course, remedied before it goes on the road. There is no question but that the apprentices use more care in fitting bolts and parts on the locomotive after such an experience, or that they realize the necessity for care and accuracy on any work that they may do, either on the machine or erecting side of the shop.

Another device that has been used successfully by some instructors is to give the individual apprentice a series of questions when he has worked in a particular department, which will familiarize him with the different parts and give him a better idea of their functioning and service.

Related or Technical Instruction

There seems to be no question but that a considerable amount of related instruction should accompany the training and experiences in the shop. This includes mathematics, mechanical drawing, freehand sketching and technical information related to the trade. The apprentice should also understand such special rules or regulations, company or government, which pertain to his job and to a certain extent, also, to the equipment on which he works. To some degree this may be covered by talks or discussions led by shop specialists or service men associated with the railway supply manufacturers. Obviously this related study should be as closely co-ordinated as possible with the apprentice's work in the shop.

Some of the railroads give this related instruction in a classroom on company time, with the understanding, however, that assignments will be made calling for the expenditure of about the same amount of time in study outside of work hours. In other instances the apprentices meet in classrooms on their own time. On still other roads they do not meet as a group, but turn in written work and confer as individuals with the apprentice instructor at more or less regular intervals. Occasionally in such instances the group may get together for special programs.

A few roads have developed their own educational material or courses. In other instances it is purchased from concerns which specialize in preparing texts and also in checking and grading the lesson papers and assisting in supervising the training. The task of preparing the texts for a large number of trades and keeping them up to date is such that the tendency seems to be to depend more and more upon outside sources for this material. It will always be desirable, however, to make sure that it takes into consideration special standards or practices of the particular

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Officers Elected for 1941-1942

***President:* J. E. Goodwin, master mechanic, Mo. Pac. (I.-G. N.), San Antonio, Tex.; *first vice-president:* J. E. Topping, master mechanic, C. & O., Hinton, W. Va.; *second vice-president:* S. O. Rentschler, general foreman, locomotive shops, Mo. Pac., Sedalia, Mo.; *third vice-president:* C. D. Allen, master mechanic, C. & O., Silver Grove, Ky.; *secretary-treasurer:* C. M. Lipscomb, Mo. Pac., North Little Rock, Ark. *Executive Committee (elected to serve two years):* W. E. Vergan, supervisor of air brakes, M-K-T, Denison, Tex.; G. A. Silva, shop superintendent, B. & M., North Billerica, Mass.; G. E. Bell, general foreman, I. C., McComb, Miss.**

railroad. There seems to be a growing tendency, also, to have such instruction and study done outside of working hours, thus preventing interference with the shop operations and production.

In some instances, where the facilities are available, the apprentices enroll in public night schools, particularly where the students in these night schools are largely railroad shop employees. Railroad shopmen and supervisors are frequently engaged as the instructors in such night schools.

It will thus be seen—and it is quite to be expected—that there are a variety of methods for giving this related or technical instruction. Some roads prefer one type; others, with different points of view or facing different conditions, prefer another. It has been suggested that no apprentice training program can be wholly successful or efficient unless the technical training or related instruction is based on a required study schedule.

The important thing—far more essential than any particular method or practice—is that the leaders of the department be sincerely interested in the training and the welfare of the young men in their charge. The right attitude on the part of the officers and supervisors, and the right kind of apprentice supervisor or instructor, may mean far more than the methods of instruction. This does not mean that the training schedule should not be strictly adhered to, or that essential details of the program as a whole should not be closely followed. It does mean that a wise and tactful apprentice supervisor with a liking for young men, and strongly supported by his superiors, *is the prime essential.*

Building Men

Workers will put forth their best efforts when they are interested and happy in their work. No two men are alike. Each one of us has a peculiar individuality and special capabilities, good and bad, which may lie dormant, or may be developed under favorable conditions. The ideal of American democracy is to develop the good talents of the individual to the utmost of his capabilities. This cannot be done in a mechanical way. It requires a careful study of each individual and his peculiar temperament. Incidentally, this is one of the strong reasons why the railroads profit from having apprentice supervisors and instructors, who can carefully and critically study and deal with each individual.

It is not meant by this to infer that the wise and tactful foremen and supervisors do not have their contribution to make to this particular phase of the problem, but ordinarily their routine duties and other responsibilities do not give them adequate time for entirely taking over this responsibility.

With this thought in mind, there is another phase of apprentice training that can be most helpful in developing the young men. It might well be termed extra-curricula activities carried on outside the shop, or outside the classroom, and not taken into consideration in the related technical training. This activity exists in several forms and need not follow any one special pattern.

An apprentice club, for instance, with the apprentices as the officers and with an apprentice instructor or some interested person or group in an advisory capacity, has been found to give excellent results. Here the boys can develop their leadership abilities, can secure practice in conducting meetings and taking part in them, and can find real inspiration and instruction of a broader type as well. They can vary their programs by occasionally bringing in speakers from the outside, either railroad men or railway supply representatives; they can carry on their own social, recreational or athletic programs; they can study about the place that transportation plays in our economic and social life, and particularly as to the part that the railroads are qualified to fill. This will not only intensify their interest in their particular crafts, but will help them to develop along broader lines and become strong and intelligent workers and citizens. Some of these clubs have even exercised an influence for good in local community affairs.

The AREB or American Railway Employed Boys Clubs, sponsored by the Railroad Y. M. C. A., have inspired the young men to high ideals of service. In whatever form such activities are conducted, they are an important and really essential element in the training program, although of a more or less, or even entirely unofficial character. Your committee in its studies and thinking has characterized this particular part of the program as "building men"—helping each individual to make the most of his particular talents and personality.

Sympathetic foremen, apprentice supervisors and instructors, and mechanics, have always been faced with the problem of advising the young men who come to them with their personal problems. They have had to act as "daddies" in a way—and frequently more effective than real "daddies" could have done.

A new phase of this problem has come to the fore in more recent years, since the lads have been better paid and are of a higher average age. Many of the apprentices now get married, and some of them fairly early in their apprenticeship. Young and inexperienced as they are, they sometimes have serious home difficulties, and more often than not these are of an economic nature. More than one apprentice supervisor has found when he diplomatically followed through on an apprentice who was not giving a creditable performance, that the difficulty was back in the home. One wife of an apprentice supervisor made a big place for herself in the hearts of the young people by getting acquainted with the wives of the apprentices, bringing them together, and helping them with their domestic problems. While this has no place in the formal apprentice training program, it does emphasize the necessity for dealing with this whole problem on a broad basis. It is not easy to evade the challenge that faces squarely those engaged in any serious attempt to educate young people in any field of endeavor—the responsibility of helping to "build men."

Merit Incentives

Americans always respond to competition—to the spirit of playing a game. There is much to be said for injecting certain incentives into the training to encourage the young men to put forth their best efforts.

The mere mention of a few things of this sort will suggest others. They may include assignment to help on special tests, even to making road trips on a dynamometer car. A trip over the division in the locomotive cab, assisting the fireman, will emphasize the stress to which the locomotive is subjected and the need for first-class work in its repair and maintenance—and the apprentice will get a real "kick" out of the adventure.

Then there are assignments to the mechanical engineer's office for a spell at blueprint making and drafting; accompanying and assisting an inspector at the works of the locomotive builder; or being detailed to a special shop for work on Diesel-electric locomotives. There are also such items as appointment on the shop committee on safety, or helping to pilot groups of "fans" on a shop visitation. These are only suggestive of the wide variety of incentives that may be developed with a little thought and study, and they certainly do produce results in stimulating a broader interest and more intelligent effort on the part of the young men.

Can anyone estimate the effect of that gathering of about a thousand people at Sayre, Pa., on the Lehigh Valley, when the apprentices were the dinner guests of the community; when the President of the road complimented them after the work and study performance records of about twenty of the leaders had been shown on the screen?

Keeping Track of the Apprentices

What kind of records are kept as to the progress and accomplishments of the apprentices? Are they left largely to themselves and allowed to drift along unnoticed? Are they rated more or less mechanically and only on their written work? Is any record kept of their shop performance, or of their capabilities?

Naturally, here again, there are a variety of practices. On some roads each foreman is required to report periodically on the performance of the apprentices, usually when they have completed their assignments on a particular class of work. Such reports are comprehensive enough to gage the personality of the apprentice, as well as his work performance. While not so intended, they also gage the supervisor's personality to a certain degree, when a comparison is made of the reports of several of them on the same young man. This, however, is a bit beside the question.

Let us consider three types of such reports that are made periodically for each apprentice. The Canadian National grades each young man on four qualities, allowing 10 points as the maximum for punctuality, 20 for initiative, 20 for discipline, and 50 for ability. There must, of course, be a common understanding as to just what is meant by these four expressions.

Punctuality is defined as the quality of being punctual, characteristic of keeping the exact time of an appointment or engagement.

Initiative is the power of commencing, going ahead.

Discipline is defined as mental or moral training, education, subject to control, to train to obedience or efficiency.

Ability is the power to perform, skill to achieve, capability for carrying out, capacity to devise, receive, retain, talents or gifts.

By way of contrast, the Louisville & Nashville has a somewhat different series of characteristics. The apprentices are rated "above," "normal" or "below" on the following ten abilities:

Dependability: Prompt, trustworthy, reliable.
Attitude toward work: Interest.
Ability to catch on: Learns fast, profits by experience.
Safety: Works safely, avoids "horseplay."
Quality of work: Accuracy.
Quantity of work: Speed.
Reaction to criticism: Co-operation.
Initiative: Leadership.
Perseverance: Persistent.
Congeniality: Ability to get along with others.

The Lehigh Valley grades on still another combination of characteristics and also on the quality and amount of work performed. The foremen report monthly on each apprentice, grading them poor, fair, good or excellent on the following ten items: Interest, initiative, industriousness, personal neatness, conduct, ambition to learn, ability to learn quickly, craft skill, observance of safety rules, and co-operation. They also indicate whether the quality of work is better, equal, or inferior to that of the average mechanic; and whether the amount of work is more, equal, or less than that turned out by the average mechanic.

What an asset to good management to have such rating systems in effect!

The Apprentice Instructor

A question frequently asked, and not easy to answer is, "What are the qualifications of an apprentice instructor?"

Many qualities are required, and we shall not attempt to catalog them. We might get lost in the forest because of the great number of trees, and then, also, certain compromises will have to be made in most instances. There are not enough 100 per cent men available.

Some few special talents, however, are essential. He must be a first-class mechanic. He must have a fairly broad background, a keen sympathy and liking for young men, and qualities suited to teaching and leadership. Leadership, not in the sense that he must be a boss, but rather that he should inspire the young men to assume the largest degree of initiative of which they are capable. He must be willing to make sacrifices of time and energy in the effort to help and inspire the young men. Such unselfishness is usually found in men of strong spiritual convictions.

Small Shop Problem

It is difficult to give the apprentice a well-rounded training in the small shop. On some of the larger systems it is the practice to transfer the apprentices from the small to the large shops for part of their training. On other roads no apprentices are maintained at the smaller places, all of the training being done at the larger shops.

The small road, with comparatively small shops, is a special problem. The solution must depend on the ingenuity of those in charge. The duties of the apprentice instructor may have to be combined with those of the foreman, or a specially well qualified foreman. The technical or related instruction may have to be arranged for by correspondence methods, by using local vocational training facilities, or by some other method. Here again no one pattern will suffice; it is necessary to adapt the methods to the peculiar conditions in the particular locality.

"Refresher" Courses

Under the quick tempo of modern developments in industry and transportation, a mechanic may become obsolete, just as does a machine or piece of equipment, unless he makes some effort and is given some assistance in keeping up with his craft. This is all the more true when we consider that some of the mechanics now in service never did have a thorough training (in the modern sense) in their craft.

Labor union leaders, as well as representatives of management, realize something of the seriousness of this problem. At least one ambitious effort was made to give courses which would be helpful to the older mechanics. It was not a very great success, but in light of later consideration, perhaps that is not to be wondered at. The course was too long—it smacked too much of school and older men don't like the implication of going back to school—the methods, perhaps were not adapted to the adults who were far from their school days.

It has been suggested that a short, intensive, peppy course be given, using the best attention getting devices. And more important, that it not be called a school or vocational course, but be tagged by some more attractive and descriptive title—a "refresher" course, for instance. We suggest further study and experimentation in this area of training, which, however, does not come within the scope of the task assigned to us.

Summing Up

Summing up, successful apprenticeship training depends upon the spirit behind the enterprise. It cannot be narrow, nor mechanical in spirit. It must have warmth and it must aim to build men in a broad sense, and to help make good citizens of them. This training comes at a formative period in the young man's life, as he is about to assume his civic responsibilities in our great representative democracy. He is away from his public school and beyond its control. No special agency for training in citizenship has yet been set up, except in a few places, although recent years have seen a tendency in that direction. Certainly his interest should, at least, be challenged in that direction.

The apprentice training program and direction must be such that it will insure the young man a thorough training in his craft, with an understanding as to how it fits into the actual operations of his individual railroad and the equipment which he helps to build and maintain, and also into the great system of transportation as a whole.

He should be so coached as to understand that in this era of technological advance he must have as broad a training in his craft as possible, and must keep up with its development in after life, so that he can the more readily adapt himself to new and changing conditions.

The report was signed by Roy V. Wright, (chairman) editor, *Railway Mechanical Engineer,* New York; C. P. Brooks, mechanical engineer, Erie, Cleveland, Ohio; Elmer Butler, assistant production engineer, Missouri Pacific, Little Rock, Ark.; Thomas C. Gray, chief engineer, Franklin Railway Supply Co., Inc., New York; William W. Haggard, general foreman, locomotive department, Atchison, Topeka & Santa Fe, Topeka, Kan.; W. V. Hirerman, assistant to superintendent motive power, Chesapeake & Ohio, Richmond, Va.; F. K. Mitchell, assistant general superintendent motive power and rolling stock, New York Central, New York; T. B. Roberts, supervisor of apprentices, Lehigh Valley, Sayre, Pa.; H. J. Schulthess, chief of personnel, Denver & Rio Grande Western, Denver, Colo.; A. A. Welton, apprentice instructor, Louisville & Nashville, Louisville, Ky.; and A. H. Williams, general supervisor of apprentice training, Canadian National, Montreal, Que.

Discussion

The discussion of this report brought out the fact that the supply of well-trained mechanics for railroad work is practically exhausted and that steps must be taken to build up a training program. Members from two roads that have pursued a constructive apprenticeship program all through the years of the depression, reported that they now find themselves in a very favorable position as regards skilled help; in fact, their roster of furloughed men has provided a backlog of men that are now serving industry and government in defense contract work.

Much was said about the selection and training of apprentices. Member after member spoke emphatically on the need for great care in picking out the boys that are to be trained; one speaker said that his road had found it worth while to follow a boy's work through school in order that the dead timber might be weeded out at the very start. Interest in the apprentice, on the part of the supervisor, is an exceptionally important factor, judging from the remarks of several speakers. A supervisor should find out what a boy is fitted for, what he wants to do

(and make a thorough check to make sure that he knows) and then follow his work through the training period to assure that proper progress is being made. The importance of practical assignments was brought out by the speaker who said "Give the boy a real piece of work; not just a job."

Other speakers discussed the ratio of apprentices to mechanics and the indication was that the members were not entirely satisfied that the one to five ratio is the proper answer. While no conclusion was reached during the discussion it was brought out that the Canadian National's system of anticipating retirements and normal turnover gave a basis for determining the number of new apprentices that should be inducted into service each year.

Other speakers said that four-year, three-year and even two-year men had been advanced to journeymen during this emergency and one road reported the promotion of helpers to mechanics jobs in which, however, they hold no seniority or displacement rights.

Report on Shop Tools

In view of the increasing use of tool steels containing such alloying elements as tungsten, tantalum, molybdenum, chromium, vanadium and cobalt, the Executive Committee of this association considered it worth while to explore the use of modern tool steels for the machining of locomotive parts with the idea of finding out to what extent railroad shops had adopted these

Table III—Machine Operation Data—Locomotive Parts

		Machine tool data						With tool steel formerly used					With tool steel now used				
Road symbol	Name of part and material	* Capacity; make; type	Age yrs	Motor hp.	Machine cond'n.	Oper. No.	Description of operation	Tool steel used	Speed fpm.	Feed in.	Time per piece h.m.s.	No. pcs per tool grinding	Tool steel used	Speed fpm.	Feed in.	Time per piece h.m.s.	No. pcs. per tool grinding
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
AA-4-1	Valve bull rings - Hunt-Spiller iron	24-in. Cincinnati engine lathe	10	10 dc	Good	1	Roughing	Rex AA	33	.037	2-30-0	1	Rexalloy	60	.030	1-30-0	10
						2	Finishing	Rex AA	33	.037	0-30-0	1	Rexalloy	70	.030	0-45-0	10
AA-4-2	Valve rings (blank) - Hunt-Spiller iron	24-in. Cincinnati engine lathe	10	10 dc	Good	1	Roughing	Rex AA	33	.037	7-0-0	1	Rexalloy	60	.030	5-0-0	10
						2	Finishing	Rex AA	33	.037	3-0-0	1	Rexalloy	70	.030	2-0-0	10
AA-4-3	Steel wheels	55-in. engine lathe	35	15 dc	Fair		Refacing hubs	Rex AA and grinding	15	.085	6 to 8 hours	10	Firthite	75	.085	1-30-0	1
AA-4-4	28-in. Piston bull ring - Cast iron	60-in. Niles-Bement-Pond boring mill	35	13 dc	Fair	1	Roughing	Rex AA	29	.050	4-30-0	1	Firthite	63	.032	3-30-0	40
							Finishing	Rex A	40	.050	3-0-0	1	Firthite	80	.032	2-30-0	40
AA-4-5	Truck boxes - cast iron	50-in. Niles boring mill	40	5 dc	Poor	1	Roughing	Rex AA	36	.035	2-0-0	2	Firthite	65	.020	1-30-0	20
							Finishing	Rex AA	24	.281	0-30-0	2	Firthite	81	.030	0-30-0	20
AA-4-6	Valve chamber bushings - Cast iron	50-in. Niles boring mill	40	5 dc	Poor	1	Roughing	Rex AA	28	.035	5-30-0	1	Firthite	63	.020	3-45-0	10
							Finishing	Rex AA	21	.312	1-30-0	1	Firthite	63	.125	1-15-0	10
AO-3-1	Main and side rod bushings-Bronze	24-in. Gisholt vertical	5	Belt	Good	1	Roughing	Carbon	120	.062	0-50-0	4	Carboloy	350	.062	0-25-0	60
						2	Finishing	Carbon	120	.062	0-20-0	6	Carboloy	400	.052	0-20-0	60
AO-3-2	Piston rod - steel	24-in. x 11-ft. engine lathe	8	15	Good	1	Roughing	High speed	80	.125	4-0-0	1	Kennametal	210	.060	3-0-0	3
							Finishing	High Speed	80	.062	2-0-0	2	Kennametal	350	.030	1-0-0	5
AO-3-3	Wheels - rolled steel heat treated	52-in. Betts vertical boring mill	2	15	Good	1	Roughing	High Speed	29	.025	0-30-0	6	Kennametal	77.75	.025	0-20-0	14
							Finishing	High Speed	29	.077		14		77.75	.077		14
AO-3-4	Driving wheel tire - steel	90-in. Betts boring mill	10	40	Good	1	Roughing	High Speed	35	.180	0-20-0	1	Kennametal	180	.030	0-20-0	8
						2	Finishing	High Speed	35	.250		1	Kennametal	180	.030		8
AO-3-5	Axles and crank pins - steel	24-in. x11-ft. engine lathe	5	15	Good	1	Roughing	High Speed	60	.125	6-0-0 (axle)	1	Kennametal	260	.044	1-0-0 (axle)	3
						2	Finishing	High Speed	50	.062	3-0-0 crank pin	1	Kennametal	360	.011	1-30-0 crank pin	5
AO-3-6	Piston valve bull ring - Hunt-Spiller iron	5-in. Libby turret lathe	15	20	Fair	1	Roughing	High Speed	45	.068	1-0-0	3	Stellite J	65	.068	0-45-0	12
						2	Finishing	High Speed	45	.025	0-30-0	3	Stellite J	65	.025	0-15-0	24
AN-5-1	10-in. to 12-in. diameter side rod bushing - bronze	36-in. Bullard vertical turret lathe	1	20ac	Good	1	Roughing	18-4-1 High Speed	120	.062	0-35-0	3	Kennametal	325	.062	0-20-0	75
						2	Finishing		120	.062	0-25-0	3	Kennametal	325	.062	0-15-0	75
AB-1-1	Rod bushing - bronze	24-in. Bullard vertical turret lathe	4	15 dc	Good	1	Semi-finish (Bore and turn at same time)	Air chuck used			metal molded castings		High Speed	284	.027	0-21-0	30
AB-1-2	Driving box - steel	Ingersoll duplex milling	4	7½ dc	Good	1	Mill shoe and wedge faces						High Speed steel milling cutters	40		0-42-0	50
AB-1-3	1¼-in. x 14-in. Taper bolts - engine bolt iron	3-in. Jones & Lamson, 8A saddle type turret lathe	1	10 ac	Good	1	Point end of bolt	No air chuck used					Rex AAA	100		0-0-15	1,000
						2	Turn taper						Rex AAA	100	.033	0-4-0	150
AB-1-4	Driving box - steel	42-in. Bullard box borer	17	30 ac	Fair	1	Bore and face						High Speed	150	.068	0-40-0	15
AB-1-5	Crosshead shoe - Hunt-Spiller iron	24-in. x 8-ft. Ingersoll bed type	4	15 ac	Good	1	Mill guide surface						High Speed steel milling cutters	77		0-17-0	65
BJ-6-1	Driving axle 0.40 carbon steel	Monarch 26-in. x 9-ft. engine lathe	4	25 ac	Good	1	Roughing	High speed	50	.062	3-0-0	3 grinds per axle	Y-13 Stellite	120	.062	1-30-0	1
						2	Finishing	High speed	50	.062	6-0-0	3 grinds per axle	Stellite Y-13	120	.062	3-30-0	1
BJ-6-2	Tapered engine bolts S.A.E 3140 steel 1-3/8-in. x 12-in. bolts	Jones and Lamson 3-in. flat turret lathe	2	10 ac	Good	1	Turning taper	High speed	60	.031	0-6-0	35	Stellite Y-13	120	.031	0-3-0	100
BJ-6-3	Crosshead shoe - gun iron	Ingersoll 36-in. x 144-in. slab miller	15	25 ac	Fair	1	Milling cross-head fit	High speed	60	1.75	0-7-0	50	Rex 18-8	60	2.25	0-5-30	100
BJ-6-4	Piston head - gun iron	36-in. Bullard vertical turret lathe	18	15 ac	Fair	1	Boring and turning ring grooves and facing	High speed	60	.062	3-12-0	1	Stellite Y-13	120	.062	1-48-0	2
BJ-6-5	Rolled steel wheels - 0.65 to 0.80 carbon; rim-toughened	Sellers 42-in. car wheel lathe	13	50 ac	Fair	1	Turning contour	High speed	28	.375	0-30-0	3 to 4	Rex 95	28	.375	0-30-0	6 to 8
BJ-6-6	Rolled steel wheels; 0.70 to 0.80 carbon	Niles 42-in. car wheel borer	14	25 ac	Fair	1	Rough boring	High speed	72	.062	0-24-0	5	Rex 95	72	.062	0-24-0	12
						2	Finish boring	High speed	72	.062	0-24-0	5 to 6	Rex 95	72	.062	0-24-0	16

new tools and the purposes for which they are now being used.

This report deals with the uses that are actually being made of these newer tool steels and is not in any sense a recommendation with respect to potential uses for them.

The committee sent questionnaires to members of the association on 23 railroads in the United States requesting data on the performance of modern tool steels as compared with those formerly used on the same operation under identical conditions as to material and facilities. Replies were received from seven railroads. The tabulation appears in Table III. [Tables I and II showed the forms used and an analysis of the jobs on which the railroads have reported that these modern cutting steels are being used. They are not included in this abstract.—EDITOR.]

A study of Table III will indicate the extent to which a limited number of railroads are using modern tool steel, the jobs on which they are being used and, in specific cases, the comparative results obtained by the use thereof. The committee drew attention to the fact that because of the limited scope of information obtained this report must, of necessity, serve primarily as an indicator of the use of modern tool steels for locomotive parts machining operations.

Because of this fact, the data are presented in detail so that those interested in this subject may see the character of the information which forms that part of this report and draw for themselves such conclusions as may be possible from the available information.

The committee suggested that this subject is of sufficient importance to warrant a continuance of this study with the object of obtaining machine operation data sufficiently comprehensive in scope that those concerned in work of this character may be able to determine from reliable data: (1) the type of locomotive parts machining operations which can more efficiently or economically be performed with the aid of modern tool steels; (2) the extent to which these tool steels can be used on the older machine tools and the performance that may be expected under such conditions; (3) to what extent the use of modern tool steel on modern machine tool equipment will contribute to the justification for replacing a large part of the obsolete machine tool equipment now in railroad shops.

Under the present priority control of tool steels such as those containing tungsten it will probably be necessary to make a very careful study of the machining jobs involved in locomotive work with the idea of using the high-production types of tool steels on that class of work where they are most needed and can best be justified.

The report was signed by W. W. Brown, shop supervisor, B. & M.; E. A. Greame, tool foreman, D. L. & W.; W Hurst, supervisor shop machinery and tools, N. Y. N. H. & H.; F. Perkins, shop superintendent, G. T. W.; L. H. Scheifele, engineer of tests, Reading; J. I. Stewart, supervisor shop machinery, N. Y. C. and H. C. Wilcox, associate editor, *Railway Mechanical Engineer.*

Discussion

The limited discussion of this report was confined to the question as to how the railroads could get high speed and carbide tools during this emergency. Two members reported that, so far, they had had no great difficulty but suggested that shop supervisors responsible for this work should make immediate studies to determine what types of tool steels offer the best production as substitutes.

Report on Lubrication

Maintenance depends largely on proper lubrication, and proper lubrication depends on the condition and efficiency of the lubricating devices. Therefore, since the mechanical lubricator is one of the factors which affects locomotive maintenance, the maintenance practices embodied in this report are submitted for consideration.

All mechanical lubricators, piping, pipe fittings and detailed parts are to be railroad standard in size, material and design for the locomotive to which they are applied and are to be applied and maintained in accordance with the latest drawings and instructions, unless otherwise authorized by the officer in charge of lubrication.

Oil Pipes and Fittings:—Properly anneal and blow out thoroughly all oil pipes before applying. Oil pipes leading to stokers, air pumps, and feedwater heaters are to be applied as far as possible under the jacket and are to be properly clamped. Cover all oil pipes not under jacket with approved covering. It is recommended that dividers not be used on steam operated units.

Heater Pipes:—Heater drain line to discharge between frames with end visible from outside so observation can be made as to whether or not the pipe is open. Cover all exposed heater pipes with approved covering. The arrangement of heater pipes, heater line connection and use and size of chokes in line are to be in accordance with special instructions of the officer in charge of lubrication. Desirable temperature of oil in lubricator is approximately 125 deg. F. For efficient operation of lubricator, it is important that the maximum temperature of the oil does not exceed 150 deg. F.

Terminal Checks:—Apply in rigid upright position whenever possible.

Method of Piping Lubricators:—(Several diagrams were included in the report showing how various types of lubricators should be connected.—EDITOR.)

The efficiency of units should not be less than that shown in Table I.

Ratchet Levers:—Avoid, wherever possible, any offset in lubricator ratchet lever.

Air Pump Auxiliary Lubricator:—Where automatic or similar type lubricator is part of standard equipment for lubricating air pumps, it is to be applied by inserting a pipe tee in air pump steam line close to and ahead of pump governor (between turret and governor) and attaching lubricator in an upright position.

Table I — Desired Efficiencies of Mechanical Lubricators

	Ratio Drivers to Ratchet*				
	Freight		Passenger		
	23 to 1 or less	More than 23 to 1	23 to 1 or less	More than 23 to 1	Yard
Valves, per cent	80	100	60	100	80
Cylinders, per cent	80	100	60	100	80
Feedwater pumps, per cent	70	80	60	80	60
Stoker, per cent	70	80	50	70	60
Air pump, per cent	60	70	50	70	80
Guides, per cent	60	70	50	70	50
Engine trucks, per cent	40	60	40	50	40
Boiler bearings, per cent	40	60	40	50	40
Trailer truck, per cent	40	60	40	50	40
Drifting valve, per cent	40	40	40	40	40
Receiver pipes, per cent	60	60	..	..	60
Intercepting valve, per cent	40	40	..	..	40
Other miscellaneous units, per cent	40	40	40	40	40

* Ratio referred to in the above table means complete revolutions of drivers to one of the ratchets at full cut-off for yard engines, 45 per cent cut-off for freight engines and 25 per cent cut-off for passenger engines.

Setting of Lubricators

Setting Schedule:—The adjustment of individual feeds is to be the same for all locomotives in a class and in accordance with schedule furnished by the officer in charge of lubrication.

At maintaining points it is desirable to have an employee designated to set all lubricators and maintain a record of date set and the setting. After feeds are set to deliver the required amount of oil, fasten the lid securely, sealing where possible. Under no circumstance is this seal to be broken, unless trouble with lubricator or amount of oil delivered is reported or found on inspection.

Inspection

Daily Inspection:—Inspect lubricators at the end of each trip. Open drain valve at bottom of lubricator and allow all water to drain out before refilling with oil. Report to foreman immediately any water found in lubricator. Make sure all bolts

and nuts through driving mechanism are tight and cotter pins (where specified) are in place. See that all pipe joints and clamps are tight. Excessive lateral movement in valve motion is to be watched, as this has the tendency to put undue strain on lubricator lever and its connections. Report and correct all defects before engine is again dispatched.

Refilling:—Do not open cover for refilling; always use filling plug or cap. Do not use reclaimed oil from hydrostatic lubricators. Use clean oil, drawn in clean receptacle and kept clean until used. Before removing filling plug or opening cap, clean around the opening with steam or air; steam preferably, to prevent cinders and foreign matter getting in lubricator. Do not fill lubricator higher than "full" mark on gauge glass or measuring stick. This is done in order to provide space for expansion when heater is used and to prevent overflowing through the cover, causing waste of oil. It is advisable to warm the oil before pouring it into the lubricator.

Protecting Covers:—When locomotives are being washed or cleaned, canvas covers should be used to slip down on lubricator during the washing or cleaning period, to prevent water from getting into the lubricator.

Thirty-Day Inspection:—(Automatic or similar type lubricator.)

Automatic or similar type air pump lubricator, where applied, must be removed, thoroughly cleaned and inspected, to be sure that all parts are open and that choke is not stopped up. If the lubricator is not working properly, replace with one in good condition and send it to general repair point.

Six-Month Inspection:—Cleanse outside of lubricator with steam before opening, break seal (if sealed) and drain all oil from lubricator. If seal is broken at time of inspection, this should be reported to foreman in charge who will report same to the master mechanic, and all settings of adjusting screws checked and corrected.

[Note: The report included detailed suggestions for the inspection of specific makes of lubricators. This same method of treatment was followed with respect to maintenance practices for different makes of lubricators. This abstract includes only the general suggestions which apply to all types.—EDITOR.]

Maintenance

The only maintenance necessary at any outlying or non-maintenance point is to fill lubricators properly and maintain pipe joints, connections and pipe clamps so as to prevent leakage. Replace all inoperative terminal checks with serviceable checks and send check removed to a maintenance or general repair point for inspection and repair.

The maintenance necessary other than that required at periodical inspection periods is when improper lubrication of locomotive or accessories or leaks or other defects are found or reported, necessary repairs are to be made.

When locomotive or accessories are not being properly lubricated and all leaky pipe joints and connections have been corrected and settings properly checked, disconnect oil pipes; open pumping units to full stroke and check unit efficiencies by hand cranking at the rate of 4 revolutions of the ratchet per minute on yard and freight engines and 14 on passenger engines. Use a one-ounce measure for measuring oil delivered.

If pumping unit fails to deliver the required minimum amount of oil for the part to be serviced, remove lubricator and make general inspection. It is preferable that this general inspection be made at a general repair point where pumping units can be accurately tested on test rack and all necessary repairs be made to the mechanism. The removed lubricator can be replaced with another if available.

Where the general repair point is not equipped with rack for testing lubricators, the lubricator should be disassembled and given general repairs and the efficiency of each individual unit should be determined by the hand crank test.

No pumping unit is to be changed from one position to another, or new or secondhand unit applied, without being tested on the rack or by hand cranking before applying the lubricator to a locomotive.

Testing Terminal Check for Leaks:—To test for leaks, connect gage to plug or cap and hand crank lubricator until gage shows pressure at which check operates. If from this pressure a leakage of more than 10 lb. occurs in five minutes, remove piping between check and lubricator and apply gage to check to determine if leak is in pipe or pumping unit. If gage test is not available, disconnect feed line to terminal check, block engine, and give engine steam. If steam exhausts through oil intake connection, the terminal check is leaking and it should be repaired before reapplying.

Another method of detecting leaky terminal check, is if oil pipes are hot for a distance of two feet from terminal check; if so remove and repair terminal check. If it is found needle valve does not seat properly, renew needle valve and seat.

Remove dirty terminal checks, disassemble, thoroughly clean, make necessary repairs and renewals, retest check and reapply to locomotive.

Oil for testing terminal checks should be 300 seconds viscosity at 100 degrees F., using a straight engine oil with no other mixture.

In cleaning and repairing lubricator never use waste as it leaves lint which may collect about lubricator screens and pumping units which may shut off oil feeds. Wash all parts with a clean cleaning solution, preferably oil, and blow dry.

Dividers, Double Pumping Units:—When dividers or double pumping units are used, they should not be used to service parts operated by steam or in connection with high pressure terminal checks. However, the use of double pumping units for servicing parts operated by steam using high pressure checks is permissible, but not desirable when it can be avoided.

Dividers when being applied must be safely located to be protected from low temperatures, as far as possible, and to be able to receive convenient inspection.

Clamp well to avoid vibration and set up all pipe connections sufficiently tight to prevent leakage of pressure.

Locate so that all delivery pipes from same will be of uniform length as far as possible.

Remove and replace all dividers that are defective or inoperative, returning the defective or inoperative dividers to the respective manufacturer for necessary adjustments or repairs, or to a repair point that can properly do this kind of work.

Dividers should be tested to determine proper distribution, the

Table II—Pumping Unit Efficiencies in Relation to Delivery

Total oil delivered		Pumping unit efficiency, per cent
CC	Drops	
12	90	40
12½	93	41
13	97	43
13½	101	45
14	105	46
14½	109	48
15	112	50
15½	116	51
16	120	53
16½	124	55
17	127	56
17½	131	58
18	135	60
18½	138	61
19	142	63
19½	147	65
20	150	66
20½	154	68
21	157	70
21½	161	71
22	165	73
22½	168	75
23	172	76
23½	176	78
24	180	80
24½	184	81
25	187	83
25½	191	85
26	195	86
26½	199	88
27	202	90
27½	206	91
28	210	93
28½	214	95
29	217	96
29½	221	98
30	225	100

Lubricator, Make and Type	Revolutions
Detroit, Model B	67
Detroit, Model A	52
Nathan, all types	80
King, all models	73
Chicago, all models	23
Edna (⅜-in. plunger)	66

same as for pumping units and when found not to distribute within 10 per cent of proper amount, should be returned to manufacturer or proper repair point for necessary adjustments or repairs. Dividers are not recommended for use with high pressure checks or steam operated units.

Special Reports:—Special report should be made on regular forms showing repairs made, efficiency of units when tested changes made, and efficiency after change to each unit; one copy to be sent to master mechanic of division to whom engine is assigned, one copy to the officer in charge of this work and one copy to be retained when lubricator is repaired and tested.

The information called for on this form should be carefully compiled and an accurate record kept of the performance of the lubricator. All lubricators receiving their first general repairs and test under this plan will have a number stenciled on top of the lubricator, showing the initials of the point and date where repairs and test were made. The form referred to should be mimeographed or printed, and handled as outlined above.

Testing Pumping Units

It is preferable that the efficiency of lubricator pumping units be determined by tests made on a test rack, specially designed for this purpose. Where test rack is not available, the efficiency of the pumping units is to be determined by hand cranking.

Test Rack Procedure

Completely submerge pumping units in light engine oil of 300 viscosity at 100 deg. F. Do not use any mixture of any other kind of oil, as this will destroy the value of relative efficiencies. Change oil with every third lubricator, using that removed for oiling shop machinery, etc.

Make all tests with pumping units in wide open position except Edna, which are set to ¼-in. stroke.

First: Test units at the slow speed test of 4 r.p.m. of the ratchet. This test to be designated by the letter "S".

Second: Test units at the first speed test of 14 r.p.m. of the ratchet. This test to be designated by the letter "F".

In each test the ratchet should be turned for the complete number of revolutions shown in the tabulation shown in Table II, opposite the make of lubricator tested and the total oil delivered by each unit in these numbers of revolutions measured, preferably in a 100 cc graduated glass.

Hand Crank Test

If a test rack is not available at the point, where in accordance with these instructions, the lubricator is to be given general repairs, (general repair point or maintaining point) the efficiency of each pumping unit is to be determined at the time the lubricator receives general repairs, by hand cranking lubricator and following the same procedure otherwise as for test rack test.

At times other than general repairs, when necessary to apply new or secondhand pumping units or when on account of parts not being properly lubricated pumping unit efficiencies are to be checked in accordance with instructions the lubricator being hand cranked in place on the locomotive and the pumping unit efficiency determined as on rack test.

Great care must be exercised in hand cranking to see that the lubricator is cranked at the specified speeds of 4 and 14 r.p.m.

The report was signed by J. R. Brooks (chairman), supervisor, lubrication and supplies, C. & O., Richmond, Va.; W. R. Sugg, superintendent fuel conservation, Mo. Pac., St. Louis, Mo.; D. C. Davis, lubrication engineer, A. T. & S. F., Topeka, Kans.; L. N. Griffith, lubrication engineer, So. Pac., San Francisco, Calif. and J. W. Hergenhan, assistant engineer, test department, N. Y. C., New York.

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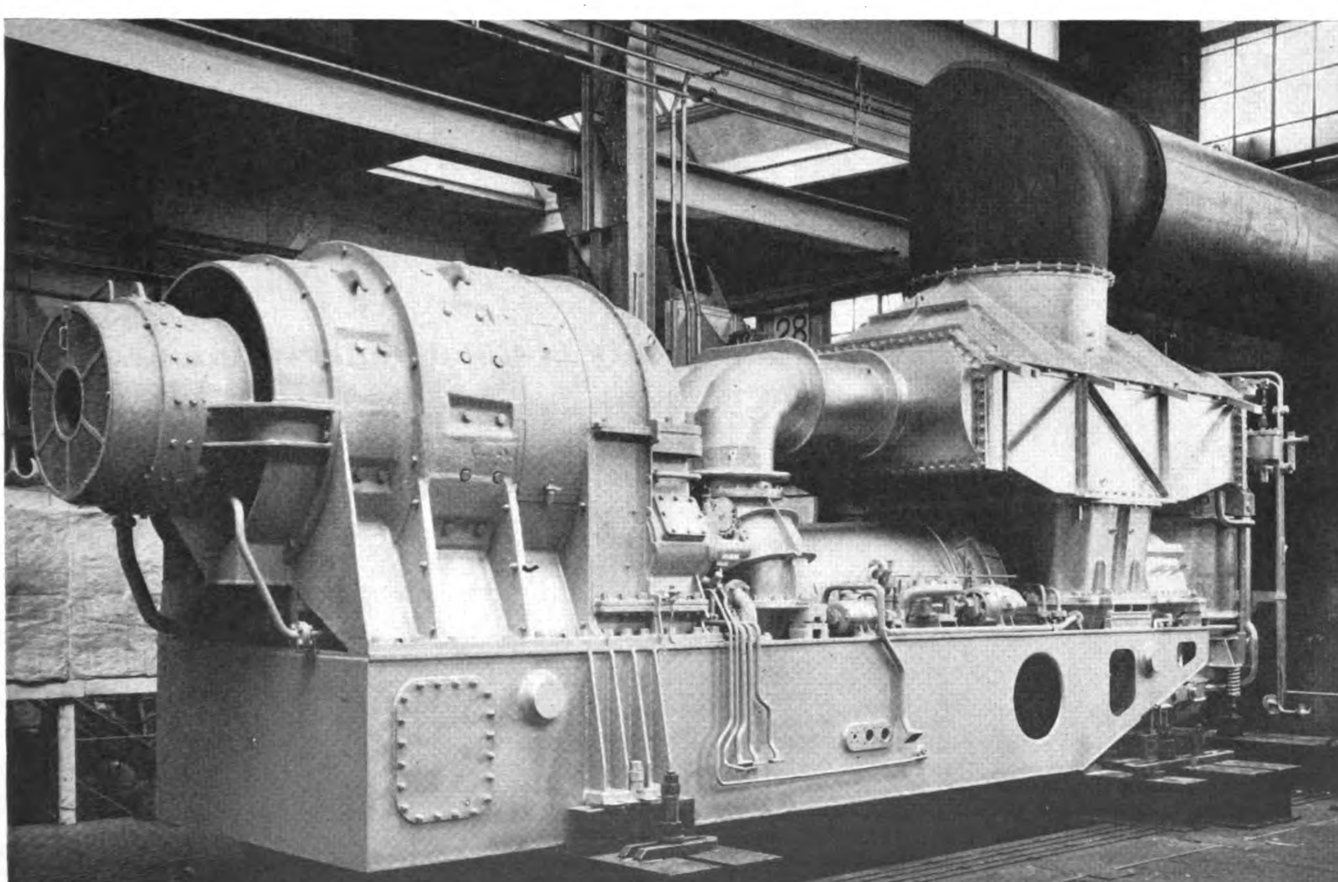


The power equipment for a gas-turbine locomotive built for the Swiss Federal Railway by Brown, Boveri & Co., Ltd.

The main generator (left) is rated at 2,200 hp.; the auxiliary generator (in the same housing) at 200 hp.; the exciter is at the extreme left—The vertical cylinder at the extreme right is the combustion chamber adjoining which are the heat exchangers (above) and the gas turbine (below)—Adjoining and directly connected to the gas turbine is the air compressor and above it the air inlets to the heat exchangers—The generators are gear driven from the compressor shaft—The complete locomotive was subjected to road tests during the summer.

Efficient Utilization Urged at M.

C. W. Buffington, President

Latest method of repairing flues, importance of treating boiler feed water, straight versus tapered radical staybolts and application of iron and steel alloy rivets were among the subjects discussed during the convention

THE twenty-eighth annual meeting of the Master Boiler Makers' Association, held at the Hotel Sherman, Chicago, on September 23 and 24, was attended by nearly 300 members and guests. The meeting was opened by an address by President C. W. Buffington, general master boiler maker, C. & O. Another address was made by C. B. Hitch, superintendent of motive power, C. & O.

Five committee reports and three individual papers were included in the program of the meeting. The papers were read by E. M. Grime, engineer of water service, N. P., on Recent Trends in Boiler Water Treatment; by Ray McBrian, engineer of standards and research, D. & R. G. W., on Steel for Firebox Boilers; and by F. P. Houston, International Nickel Company, on Staybolts.

Importance and Responsibility of Good Supervision

By C. B. Hitch

Superintendent of Motive Power, Chesapeake & Ohio

Mr. Hitch said that never was there a time when the importance and responsibility of good supervision in the boiler department should be given greater consideration. "You are aware," he continued, "of the increased difficulty and delay in obtaining various materials, particularly boiler steel. This situation is likely to continue for some time and probably will become more difficult before it improves. The conservation of material is, therefore, of the utmost importance.

"This situation throws a heavy responsibility on the supervision of the boiler department along with all other departments on our railroads, since we must be prepared to handle increased business with a decreased supply of new materials available for repairs and new construction. Therefore, we must improve our efficiency in the use of materials.

"It may be necessary, in many cases, to resort to patching where, under more favorable conditions, new construction would otherwise be used. To determine the extent to which patching should be done will require a high degree of skill and judgment on the part of the boiler shop supervision, since strength and safety must not be sacrificed. There will be a tendency to lower the quality of new materials produced, including boiler steel, and such a condition will require extra care in the inspection and selection of material if strength and safety are to be maintained.

"The conservation of material will require a high degree of skill and workmanship on the part of boiler shop labor. This applies particularly to such operations as laying out, chipping, drilling, flanging, etc., in which considerable material can be spoiled or excess used if proper care and judgment is not exercised. It is also important that the tools used in performing these various operations be maintained in good condition and in proper adjustment.

"You are all aware of the increased demands for motive power and the length of time now required to build new locomotives. This makes it necessary that present locomotives be available for service the greatest possible time, which means that time out of service for shopping and running repairs must be reduced to a minimum.

"The problem is complicated by the demand for skilled labor in the defense industries, which has decreased the supply available to the railroads. This in the face of the fact that the amount of skilled labor required by the railroads has increased due to the increase in traffic brought on by the defense program. The

# of Available Materials
B. M. A. Meeting

result has been the calling back of large numbers of men who have been on furlough for some time, and in some instances, the employment of new men who are not familiar with railroad work, and who must be broken in and trained before they can become efficient workmen. It is the duty of the supervising officers to provide the necessary training. It is impossible for the supervising officer to give each man individual attention for any considerable length of time, however, by providing adequate supervision, the situation can, if proper judgment and foresight is used, be successfully handled.

"For instance, the particular qualifications of each man can be determined and he should be assigned to the work for which he is best suited. Those having little or no experience should be given jobs requiring the least skill, while those better qualified can be given more exacting work. Also, inexperienced men should be assigned to work with more experienced men whenever possible and advanced to more difficult work as their skill develops, or assigned a certain job for which they show particular aptitude.

"This system has been tried out in other industries and proved to have the advantage of allowing a skilled force to be built up rapidly in case of emergency. However, if carried too far, it has the disadvantage of developing a large number of so-called specialists who would not be fit for general boiler work and who could not be used to advantage if there should be an appreciable falling off in the amount of work to be handled. It is up to supervision to determine just how far it should be carried. This advantage can be reduced considerably by maintaining a full quota of apprentices and by seeing that they receive proper general training.

The increased demand for available locomotives calls for increased shop output. It is up to supervision to see that the necessary work is performed, and that the output is not increased at the expense of good workmanship. It is far better to experience some delay in the shop than to risk accidents and failures on the road. The situation imposes considerable responsibility on the boiler inspectors. They are charged with the duty of reporting work necessary to maintain the boilers in a safe and suitable condition for service, and that all repair work is properly done. Under present conditions they should be particularly careful to see that no unnecessary work is called for. This will require the very best of judgment on their part.

"If the work is scheduled and the officers in charge of the main shops are informed a sufficient length of time in advance as to the condition of the boiler on each locomotive, together with the work that will be required at the next shopping of the locomotive, they can and will have on hand the necessary materials and labor to handle the work promptly and efficiently."

A. F. Stiglmeier,
Sec.-Treas.

M. C. France,
Vice-President and
Chairman Executive Board

Application and Maintenance of Flues and Tubes

The first part of this report went into the details of cleaning, cutting and safe-ending flues and tubes and described some of the recently developed equipment for doing this work in the flue shop. This abstract is confined to that part of the report dealing with the application and maintenance of flues and tube and the problem of cracks in flues.

Application and Maintenance of Flues and Tubes

On new flue sheets care is taken to drill a smooth hole which is chamfered on both sides to 1/16-in. radius, all flue holes having 1-in. guide hole punched first. 2-in. and 2¼-in. tube holes are drilled the same size as the outside diameter of tube in back flue sheet and 1/16-in. over the outside diameter of tube in front flue sheet, 3½ in. and larger are cut with a special two blade cutter, 3½ in. flues being swedged to 3 in. outside diameter. The hole in the back flue sheet is cut 5/32-in. and hole in front flue sheet cut 3 19/32 in. 5½ in. outside diameter flues are swedged to 4½ in. outside diameter and hole in back flue sheet cut 4 23/32 in., in front sheet 5 19/32 in., all work being handled on a large radial drill.

On old back flue sheets, the old welding is removed if flues are welded to back sheet and flue holes chamfered with a rose-bud bit, or filed by hand with a half-round file. Flue holes found out of round are reamed.

Flues are applied with copper ferrules, expanded and beaded. Copper ferrules are ⅝ in. wide and of varying thickness to compensate for wear in flue hole. Coppers are set in sheet 1/32 in. in on fire side and rolled in place. All flues are applied with a slight drive fit; 2 in. and 2¼ in. tubes are set to length with a tube setter sectional expander, allowing ¼ in. for the bead. Large flues are set and heeled over by hand. All flues and tubes are expanded in the back end with boss expander, turning expander three times in each tube or flue. After flues or tubes have been expanded on back end, front end is cut to length. Flues and tubes are then beaded in the back end. All flues and tubes are shimmed if necessary and rolled on front end. All superheater flues and 30 to 60 per cent of all small tubes are beaded on front end. After break-in fire up, superheater flues are light rolled and all flues run over with beading tool on back end and welded. Some railroads do not make a general practice of electric welding beads when flues are applied. In some districts flues run their life without requiring electric welding

of beads. In other districts beads are welded at 30,000 to 40,000 miles of service.

Cinder cutting is the heaviest maintenance item on high pressure and high capacity engines. It is necessary to renew part of a set of flues and tubes due to cinder cutting at 90,000 to 100,000 miles. This is generally in the form of a vee at the top and requires renewal of approximately 100 flues and 30 tubes.

When flue beads are electric welded, the flues are worked over; that is, expanded and beaded, sheet and beads sand blasted, and electric welded with boiler filled with warm water, starting welding in center and working both ways.

Arch Tubes

The following method should be followed as closely as possible, that there may be a standard application. Drill a guide hole in sheet or punch hole, then drill proper size hole for tube 1/32 in. larger than tube. Have the tube bent by a cold bending machine.

Cutting the tubes off with oxy-acetylene torch is not recommended without chipping off the slag accumulation after burning. The tubes then should be properly placed in holes and held with clamps so they will not slip. Also use gage to see that they are held straight for proper set for arch brick. Then roll and bead or flare out. We recommend that the tubes extend past the sheet 1/4 in. for beading, and 3/8 in. for belling.

The use of copper ferrules where tube holes become large is good practice, but the thickness of copper should have a limit. We recommend that the radius of arch tubes be given careful consideration, as we feel that better cleaning can be done as well as taking care of the expansion and contraction. They should enter the sheets at right angle, where possible. Good results are also being obtained where the sheet at holes are built up to 3/4 in. thick.

The Cause of Flues Cracking

Cracking is caused by the expansion and contraction of flues allowing sediment to enter the space between the flue and the copper, causing small leaks through welds. These small leaks add to the caustic contents of the scale until the flue is cracked. By applying an antidote which is immune to caustic, it is hoped that the beads will not crack.

Before this was found two locomotives, one a large Pacific and the other a large Mikado, carrying steam pressures of 215 lb. and 225 lb. respectively, had flues set without the use of copper ferrules. The back flue sheet was countersunk 1/8 in. deep, flues worked in hole the usual way and flues beaded back in center line of hole, after which flue bead was welded to sheet. This was done with the thought of keeping the flue bead as cool as possible and thus avoid flue beads burning and breaking.

These locomotives are now going into their third year, having made more than 100,000 miles each, with no trouble from burned flue beads or cracking of same. This proves that if the flue bead is kept cool, it will not crack.

The fire cracking of flues has long been the source of trouble and expense to the railroads. There is a method used in applying flues with success, that is, countersinking the sheet. Flues are flared over in the counter-sink and welded, after they have been worked. This method is shown in Fig. 1.

Some roads safe end their flues with a heavy gage safe end, but it does not correct the trouble with fire cracking, leaking from welds breaking loose and cinder cutting.

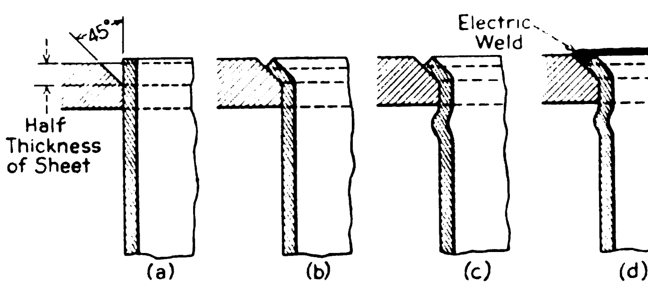


Fig. 1—Method of applying welded flues flush with sheet

In February, 1936, we devised a method of applying a sleeve to a tube, an application of which was made to a Pacific type passenger locomotive at the crown sheet, where the circulating tube enters. The original tubes are still in service, having almost five years service in heavy passenger duty. These tubes have never leaked, nor was it necessary to do any work on them, other than to clean them at monthly inspection periods. Later on this same method was used to apply arch tubes, and still later, flues were applied using this same method. There are some flues that have been in service three years, without a sign of a leak, and in no case has there been any trouble experienced since this method was used. This method is shown in Fig. 2.

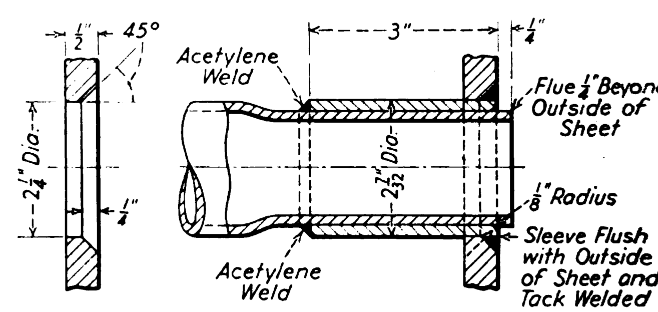
In the application of a flue, using this method, the copper ferrule is eliminated and the flue is swedged straight back to receive the sleeve, the sleeve being slightly smaller than the hole in the back flue sheet. The sleeve is welded to the flue on the water side, and when applied is left flush with the back of the flue sheet. The flue sheet being countersunk slightly. The sleeve is then welded to the sheet, after the flue has been rolled just tight in the sheet. The flue which projects over the sleeve can then be beaded, and it is optional whether the beading is welded or not.

This method has been used successfully on the circulating tubes of semi-water tube fireboxes since February, 1936 and is now used exclusively on one railroad with this type of firebox. As a matter of fact, it is a standard application and these tubes are connected to the crown sheet and side sheets with this arrangement. This method is now being used in the application of flues. It is particularly adaptable and beneficial where the tubes are subject to cinder cutting, as two thicknesses of metal, will, of course, stand twice the amount of cinder cutting.

In the application of flues, the welding of the sleeves to the flues is now being done by acetylene. The first arrangement called for electric welding at this point, but both methods are equally good. The thought was that there may be the possibility of electric weld penetrating too deep into the flue, or perhaps burn completely through, which of course, would destroy the end, so as a matter of precaution, it is recommended that the flues be welded to the sleeves by acetylene. The application of the flues, after the sleeves have been welded on the water side, should be as follows: The flue hole should be countersunk at one half the depth, at 45 deg. and after the flue is applied to the hole, the end of the sleeve should be flush with the outside of the back of the flue sheet, and rolled just tight in the sheet. The sleeve is then electrically welded to the flue sheet at the countersink, all the way around. After the sleeve has been welded to the sheet, the weld is smoothed flush with a light bobbing or chip off the weld flush with the sheet. The end of the flue is then beaded, and it is optional as to whether the beading is to be welded or not. It is not recommended that the beading be welded, as this may defeat the expansion and contraction which occurs at this point.

In October, 1940, a complete set of flues were applied by this method. These were located at critical points where cinder cutting is the heaviest, and temperatures are the highest. Inspection was made the first of this month, and it was noticed that the flues applied by the standard method were leaking and cracking; while

Sleeves Cut from Good Flues and Annealed



Note: All Welding to be Electric Weld. Flues Swedged to Suit Sleeves.

Fig. 2—Left: Hole in back tube sheet—Right: Flues applied with welded sleeves and tack welded to back tube sheet

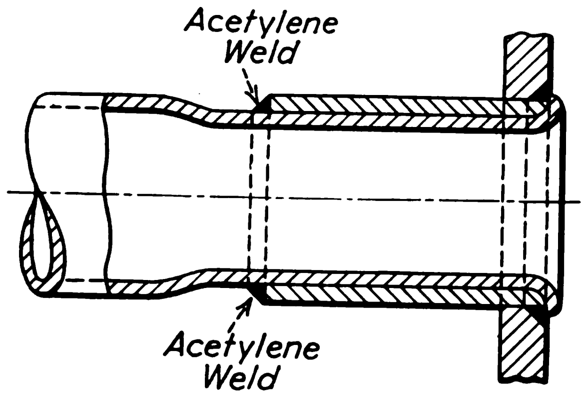


Fig. 3—Flues and sleeves rolled tight in back tube sheet, sleeves welded complete and bead applied to flues

the flues applied with the sleeve looked just the same as they were the day they were applied.

The report was signed by Frank A. Longo (chairman), general boiler foreman, S. P.; J. M. Stoner (vice-chairman), supervisor of boilers, N. Y. C.; H. A. Bell, general boiler inspector, C. B. & Q.; S. P. Mahanes, district boiler inspector, C. & O.; H. E. May, shop engineer, I. C.; G. E. Burkholtz, general boiler inspector, St. L.-S. F.; J. J. Desmond, boiler foreman, Washington Terminal Co.; W. Freischleg, boiler foreman, Wabash; T. H. Moore, general boiler inspector, W. M., and E. H. Gilley, general boiler foreman, Grand Trunk.

Discussion

There was considerable discussion on the problem of cinder cutting. Some roads tried leaving out copper ferrules resulting in increased cutting. When one road did this the mileage between flue renewal dropped to 90,000. The ferrules were restored and the mileage increased to 225,000. Another road which prossered, beaded and welded flues, obtained from 342,000 to 350,000 flue mileage. This same road obtained 577,628 flue miles on a Hudson type locomotive. It was generally agreed that no positive cure has been found for cinder cutting.

Straight Vs. Tapered Radial Staybolts

Over a period of 27 years, committees of this Association have made tests to determine the relative holding power of various types of crown bolts. The tests conducted in 1910 indicated that button-head radials showed a decrease of 56.4 per cent in holding power when heated to 860 deg. F. as compared to 70 deg. F. Tapered head radials showed a decrease of 51.4 per cent when heated to 820 deg. F. The button-head radials failed at the head and pulled through the sheet whereas the tapered-head radials sheared off the head and stripped the threads on the bolt and in the sheet. Similar tests on straight radials indicated a decrease in holding power of 60.8 per cent.

Tests were conducted again in 1921 with the following results:

Test No.	Condition of pull	Where broken	Kind of head	Lb. pull	Remarks, in.
1	Cold	Head pulled off	Button-head with 1/8 head drilled off	23,750	Plate dished 1/4
15	Cold	Bolt broke 3 inches from head	Full button-head	29,510	Plate dished 1/8
4	Cold	Head pulled through sheet	Hammered head with taper 1 1/2 inches in 12 inches	19,400	Plate dished 5/8
14	Cherry red	Head pulled off	Full button-head	7,100	Plate dished 9/16
7	Cherry red	Head pulled off	Button head with 1/8 head drilled off	7,730	Plate dished 5/16
11	Cherry red	Head pulled through sheet	Hammered head with taper 1 1/2 inches in 12 inches	2,900	Plate dished 5/16

All of the above tests with the exception of those made cold, were made with the heat as near the same temperature as it was possible to get them, that is about a cherry red. It can be seen that as long as the sheet is cold the hammered head type of bolt is of ample strength and even when the sheet is cherry red it takes 2,900 lb. to force the plate from the bolt.

Test of Steel Crown Bolts

Presuming that these previous recorded tests were made with iron staybolts it was thought to be of value to this present investigation and purpose of this topic if a test could be made of steel crown bolts as a comparison with the previous tests. Through the courtesy of the management of a railroad using all steel staybolts this was arranged. Three types of crown bolts were tested. Straight threaded bolts with hammered heads, tapered threaded bolts (1 1/2 inch in 12 inch) with hammered heads, and a button or panhead type of bolt. These were applied to section of 3/8-inch. firebox steel plate. One of each type of bolt was pulled at room temperature, and one of each type was pulled with plate and bolt heated to a dull red, about 750 to 800 deg. F.

These tests were made on a Riehle testing machine with the following results. All bolts made from 15/16 inch steel bar stock with ends upset in bolt machine.

Test No.	Condition of pull	Where broken	Kind of head	Lb. pull	Remarks, in.
1	Cold	Head pulled off and bolt out of sheet	Straight hammered head 1 1/8 inches diameter	33,020	Plate dished 1/4
2	Cold	Head pulled off and bolt out of sheet	Hammered head with taper 1 1/2 inches in 12 inches, diameter 1 1/8 inches	33,250	Plate dished 1/4
3	Cold	Body of bolt elongated	Panhead bolt, 1 1/8 inches dia., taper 1/2 inch in 12 inches	42,300	Plate dished 1/2
4	Dull red	Head pulled off and bolt out of sheet	Straight hammered head 1 1/8 inches diameter	31,200	Plate dished 3/8
5	Dull red	Head pulled off and bolt out of sheet	Hammered head with taper 1/2 inch in 12 inches, diameter 1 1/8 inches	34,850	Plate dished 7/16
6	Dull red	Body of bolt elongated	Panhead bolt, 1 1/8 inches diameter, taper 1/2 inch in 12 inches	41,750	Plate dished 1/2

It will be noted that in each test of the straight threaded bolts and the tapered bolts they failed by pulling out of the sheet, whereas in both tests of the panhead bolt the head held, the point of failure was in the body of the bolt which yielded.

The behavior of the heated taper bolt was rather interesting, although both were made at the same time from the same material, it required 1,600 more pounds to pull the tapered bolt heated than it did to pull it cold.

The test however clearly indicates the superior strength of the panhead bolt over the taper and straight radials.

Committee Not Unanimous in Opinion

The majority of this committee, basing their opinion on many years of experience, recommend the adoption of the tapered hammered head as standard. However, the question in the mind of the chairman of this committee is, "Should we sacrifice a greater degree of security for ease of application and maintenance?" For

The Newly Elected Officers

President: **Myron C. France, general boiler foreman, C. St. P., M. & O., St. Paul, Minn.; *vice-president:* Frank A. Longo, general boiler inspector, So. Pac., Red Wood City, Calif.; *secretary-treasurer:* A. F. Stiglmeier, general supervisor of boilers and welding, N. Y. C., Albany, N. Y. *Executive Committee—term expiring in 1944:* Sigurd Christopherson, supervisor of boiler inspection and maintenance, N. Y. N. H. & H., East Milton, Mass.; R. W. Barrett, chief boiler inspector, Can. Nat., Toronto, Ont.; E. H. Gilley, general boiler foreman, G. T. W., Battle Creek, Mich.**

many years the Canadian National adopted as standard the button-head type of bolt. In common with many other railroads it was decided to replace button-heads with taper headed bolts, with hammered ends on all locomotives. Thus on all new power and new firebox applications alternate sections of straight and taper crown bolts were applied. Taper 1½ inch in 12 inch. From a maintenance point of view this was very satisfactory; any leaks occurring could easily be taken care of, which admittedly is more difficult in the case of button-head application. However, experience has taught us that a greater degree of security is more essential than ease of application and maintenance. Consequently it was decided after careful consideration that as the panhead crown bolt was the design that would sustain the maximum amount of pressure, and the straight threaded hammered head bolt was the weakest, that all non-syphon locomotives passing through the shops for repairs, the crown sheets should be changed as shown in Fig. 1. The first four rows to be flexible expansion stays followed by alternate sections of panhead bolts and straight hammered head radials. These are from 10 to 14 rows wide according to the width of the firebox. Fig. 2 shows the design of the panhead crown bolt having a taper of ½ inch in 12 inch.

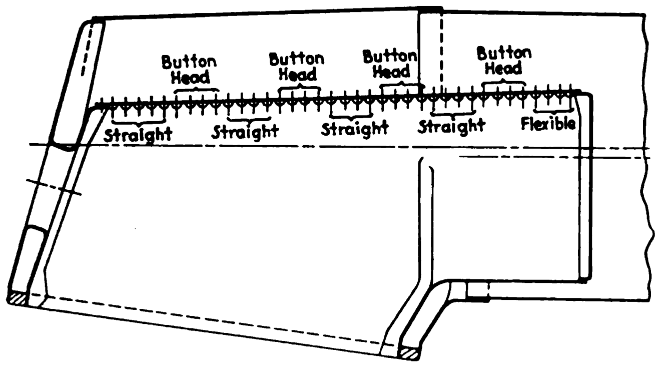
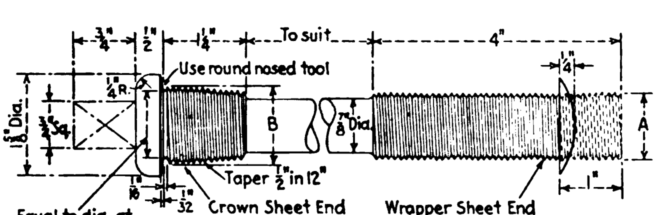
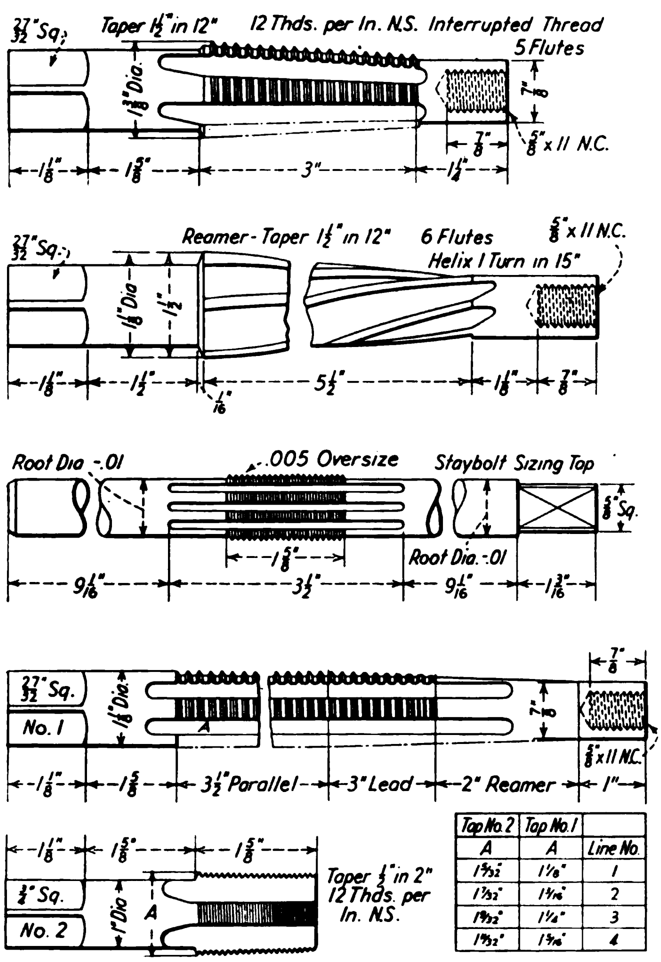


Fig. 1



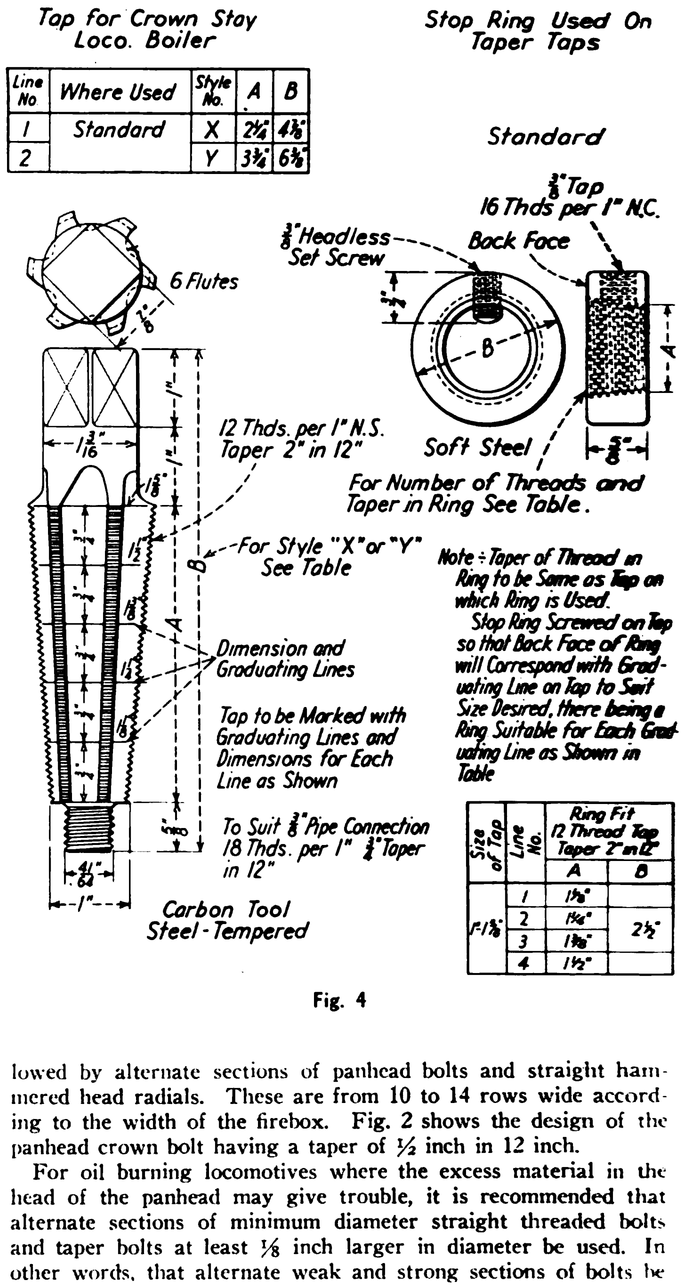
B	A	Remarks	Line No.
1 3/16"	1 1/16"	New Work	1
1 5/16" Max.	1 5/16" Max.	Renewals	2

Fig. 2



Tap No. 2	Tap No. 1	
A	A	Line No.
1 5/32"	1 1/8"	1
1 7/32"	1 3/16"	2
1 9/32"	1 1/4"	3
1 11/32"	1 5/16"	4

Fig. 3



Line No.	Where Used	Style No.	A	B
1	Standard	X	2¼"	4⅜"
2		Y	3¼"	6⅜"

Size of Tap	Line No.	Ring Fit 12 Thread Tap Taper 2" in 12" A	B
F-1⅜"	1	1⅜"	
	2	1 7/16"	2½"
	3	1⅜"	
	4	1½"	

Fig. 4

For oil burning locomotives where the excess material in the head of the panhead may give trouble, it is recommended that alternate sections of minimum diameter straight threaded bolts and taper bolts at least ⅛ inch larger in diameter be used. In other words, that alternate weak and strong sections of bolts be applied.

Taper Per Foot

A survey of previous reports as to the most desirable taper for crown bolts have shown these to vary from ¾ inch to 3 inch in 12 inch. The majority, however, favoring 1½ in. in 12 inch, as being the taper most suitable for adequate staying of the crown sheet. It being claimed for this type of bolt that once they are properly applied they are there to stay for the full life of the firebox.

The following table gives the permissible tolerances for straight taps and should be adhered to at all times.

Dia. of staybolt, in.	Minimum tap dia., in.	Maximum tap. dia., in.	Tolerance allowed
15/16	.9385	.9425	.0040
1	1.0010	1.0050	.0040
1 1/16	1.0635	1.0675	.0040
1 1/8	1.1265	1.1310	.0045
1 3/16	1.1890	1.1935	.0045
1 1/4	1.2515	1.2560	.0045

For new boilers or application of new fireboxes to boilers removed from their frames where boilers can be turned it is advantageous to use long taps in some instances. In general, however, it is recommended that short parallel taps as shown in Fig. 3 be used with spindles or pilots of required lengths.

No attempt is made to synchronize the threads of the inside and outside sheets as it is found from experience that the crown sheet will adjust itself to any little variation of pitch. The use of interrupted thread taps permits greater ease in tapping.

For the application of tapered crown bolts, the taps shown in Figs. 3 and 4 are the style most favored for this work. The reamers are also shown. These can be made from used taps ground to suit.

Steel Staybolts

The use of iron for stay and crown bolts is common on this continent, whereas those who use steel bolts are in the minority. The Canadian National was the pioneer in the use of steel staybolts, having applied these exclusively to their fireboxes for the past twenty years. Objections have been raised to the use of steel, that they are hard to drive, difficult to thread, and do not upset in the holes. This has not been the experience of the above mentioned railroad. At first when the change over was introduced men riveting staybolts noticed that the bolts were somewhat harder to drive. This was soon forgotten; also it has been found advisable on the vertical threading machines to thread steel bolts with a preliminary and finishing cut to ensure a perfect threaded staybolt. Any extra cost involved in the application of steel bolts is more than amply repaid by the freedom from broken stay and crown bolts in enginehouses. Formerly in the iron staybolt days enginehouses who did not report the renewing of 200 to 300 broken staybolts per month were suspected of neglect in their staybolt examinations, today finding of broken staybolts at monthly and annual examinations is the exception rather than the rule.

The report was signed by R. W. Barrett (chairman), general boiler foreman, Can. Nat.; Wm. N. Moore (vice-chairman), general boiler foreman, P. M.; H. H. Service, general boiler inspector, A. T. & S. F.; E. E. Owens, general boiler inspector, U. P.; L. R. Haase, district boiler inspector, B. & O.; G. L. Young, boiler foreman, Reading; Mark Manley, general boiler inspector, L. & N.; L. Nicholas, general boiler foreman, C. I. & L. and James A. Guinther, boiler foreman, L. & N. E.

Discussion

The discussion centered around the experience the various railroads have had with the tapered radial staybolt. One road reported that when it adopted this type of staybolt, crownsheet leaks were eliminated and maintenance reduced to a minimum.

Chemical Treatment of Boiler Feedwater

At the present time there is general acceptance of the theory and practice of water treatment. Most of the important main line watering stations on our railroads are receiving treatment. However, there remains a large field for further improvement in the proper application of water treatment to the remaining water supply stations on the main lines and to the water stations on branch lines, etc., as will be covered more fully in this report.

Outstanding in the development of water treatment during the last decade and of particular interest to boiler makers has been the development of testing apparatus for the control of all the various phases of these operations. Test kits have been developed for rapid field analysis of the raw and treated water supplies so that it is possible to determine the amount of treatment necessary and then check to see that the final product is up to standard. Other test apparatus has been developed that makes it possible to know exactly the condition of the water in the boiler within a few minutes after its arrival in a terminal. Thus it is possible, at all times, to control and check all factors of boiler operation whether it pertains to the condition of the heating surfaces of the boiler or to the quality of steam that the boiler is capable of producing.

Savings Effected in Boiler Maintenance and in Fuel

The railroads of the United States use about 350 billion gallons of water a year only about half of which is treated for boiler feed purposes. A conservative estimate of the scale forming matter neutralized by such treatment would be approximately 262,500,000 lb. Studies made by the Water Service Committee of the A. R. E. A. indicate a saving of 13 cents per pound of scale-forming matter removed. The actual experience of railroads has indicated savings considerably in excess of this figure. However, at a 13 cent a pound figure, the potential annual saving to the railroads would be $33,125,000.

One railroad has saved, in a decade in washouts alone, 1 1/4 cents per mile. All committee members reported that their roads had been able, where 100 per cent treatment was used, to extend greatly the washout periods. Another reports a saving of 1.2 cents per mile in boiler makers' payroll costs, and 2/3 cents saving in fuel per mile since going from partial to 100 per cent boiler feedwater treatment. From the available data, it would indicate that when all savings made possible by complete treatment are taken into account, a road should save from 4 to 7 cents per locomotive mile.

Since the proven savings due to water treatment are so great and since there is available to the railroads a further savings of upwards of $25,000,000 per year through the extension of water treatment to the remaining untreated water supplies, we unreservedly put ourselves on record as recommending the completion of the water treatment program at the earliest moment, not only for the savings to be realized, but also to obtain greater availability of power.

Pitting and Corrosion in Boilers

With few exceptions, the problem of pitting and corrosion has been minimized. The chemicals best suited for the prevention of scale formation have also taken care of all but the worst cases of attack on metal. The water service committee of the A. R. E. A. and the feedwater treatment companies have found that by carrying the proper ratio of alkalinity, together with suitable organic treatment, pitting and corrosion can be eliminated. The reports of the membership substantiate these claims. The one report we have of pitting and corrosion comes from South America where treatment of a different type than that generally in use in the United States is being used. These difficulties are being minimized by the use of supplementary treatment.

Insofar as United States practice is concerned, adherence to present practice where complete treatment is now provided and the extension of these practices to present untreated or partially treated supplies will completely eliminate this problem as a matter of any consideration from our maintenance program.

Control of Dissolved Solids and the Most Economical Method of Blowing off Boilers

The development of a comprehensive water treatment program is a complex problem, but not necessarily a difficult one. The one thing essential to success is the understanding cooperation of all departments of the railroad concerned with these operations. The engineering, operating, and mechanical departments are all involved in the program and each contributes to the success of the operation.

Proper test equipment is essential to the success of the water treatment program. Such apparatus has been made available over a period of years due to the pioneering efforts of the large

water treatment companies. Portable test kits for every kind of test of raw, treated, or boiler water are available to the railroads, together with the services of qualified men to instruct and assist supervisors in making whatever adjustments may be required as determined by such tests.

An important part of this work is the control of the amount of dissolved solids in the boiler water of engines being handled at terminals. Test apparatus is now available which indicates the total dissolved solids in a quick, simple manner. The use of this apparatus determines the actual condition of the boiler water and the resultant figures may be used on the work report to justify continued operation of the boiler without either a water change or boiler wash if the readings show that such work is not required. Frequently it is only necessary to blow down one or two glasses of water in order to condition the boiler for another trip, thus keeping the locomotive in service.

The best types of apparatus for such terminal testing use the electrical conductivity principle. The Nalcometer furnished by the National Aluminate Corporation is of this type. Corresponding apparatus known as the Dearborn Concentrometer is furnished by the Dearborn Chemical Company.

We are further advised by the chemical companies that their research departments are continuing their studies working toward producing treatments which will permit carrying higher dissolved solids in the boiler waters. This would permit safe operation with a reduced blow-down schedule and is a worthwhile development.

The blowing of boilers is equally important. We find that most railroads control the blowing by the intermittent use of the large blow-off cocks. A great many improvements have been made in design and location of intermittent blow-down equipment, so as to take care of localized conditions of the various railroads. The use of the automatic continuous blow-off equipment has been extended during the past years, as has the electromatic system of blowing. The further use and improvements of these automatic systems of blow-down will, no doubt, be made, to the benefit of all railroads.

We have learned that all natural waters analyze differently from a chemical standpoint. Since all waters are not the same chemically, the equipment and treatments to treat these various waters, must be designed so that a uniform result is obtained. If railroads are to take full advantage of 100 per cent treatment of boiler feed waters, the railroads themselves must have this department organized and controlled so that complete cooperation will be had between all other departments.

This association is well aware of the research work that has been, and is now being done by the water treating companies and other research institutions. It would appear that our duty as railroaders, is more clearly to determine the actual saving that has and can be made, by the use of water treatment, and to see that such savings are made. Since such savings must include the study of the quality of water, type of treatment, and maintenance and operating cost figures, it would seem advisable that the A. R. E. A. Water Service Committee and the Master Boiler Makers' Association should work on the project of developing suitable figures covering the actual savings that can be made by properly treating all types of boiler feedwaters. We have been advised by some members, located in the South and East, that they have been unable to justify expenditures for treatment on low-hardness, high-silica-content waters by the use of the A. R. E. A.'s 13-cent figures, whereas, it is known that the maintenance cost, in actual practice, far exceeds the cost of proper water treatment.

The report was signed by Carl A. Harper (chairman), general boiler inspector, N. Y. C. (Big Four); I. N. Mosley (vice-chairman), master boiler maker, N. & W.; S. E. Fegan, district boiler inspector, Can. Nat.; F. H. Maurer, boiler foreman, B. & A.; E. Crapper, chief boiler inspector, Buenos Aires Great Southern (Argentina); R. L. Guanero, general boiler foreman, D. & R. G. W.; A. P. Roberson, district boiler inspector, Great Northern, and L. J. Johnson, Jr., boiler foreman, F. E. C.

Discussion

Two prepared discussions and an illustrated talk by W. C. Schrader, Bureau of Mines, Washington, D. C., followed the presentation of this topic. Mr. Schrader stated that three factors combine to produce inter-crystalline cracks in a boiler. (1) leakage that allows concentration of the boiler water; (2) high stress in the boiler metal arising either from cold work or applied stress; and (3) chemical action of the concentrated boiler water on the stressed steel. He then presented slides which showed the design of an embrittlement detector that can be attached to the side of the locomotive boiler. This device was described in an article on page 262 of the July, 1940, issue of *Railway Mechanical Engineer.*

He then showed test results using waste sulfite liquor in the feed water of both carbon steel and high alloy steel locomotive boilers. The use of this chemical slightly reduced the cracks in the boiler steel. Sodium nitrate was then used in similar locomotive boilers with the result that no cracks appeared in the boilers under tests. These tests, he said, indicated that they have gone far in finding the solution to caustic embrittlement or intercrystalline cracking.

Shop Kinks and New Ways of Doing Things in the Boiler Shop

This report was a collection of notes and drawings on methods of performing boiler operations found satisfactory by members of the association. From a group of 17 ideas illustrated in the report a selection, shown on these two pages, was made. Fig. 1 shows a method of patching a syphon-equipped boiler so that about nine welds may be eliminated in a troublesome zone. Fig. 2 shows an improved type of cylinder head casing fabricated by the use of welding. Fig. 3 is a method for providing the air pump clearance at the smokebox front. Welding is again used in the manhole cover hinge in Fig. 4. When it becomes necessary to renew an outside throat sheet without removing the boiler from the frames the manner in which it may be accomplished is seen in Fig. 5. Fig. 6 shows an arrangement for tender tank splash plates which was found to be without cracked sheets or loose rivets after eight years service. Experience indicates that the sheets should be flanged not less than 2 in. or more than 3 in. for best results. Fig. 7 is a home-made holder-on of the yoke type by means of which work can be done on shell courses without removing the dry pipe or on outside throat sheets without removing the combustion chamber. These are only two of its many uses. A strong and solid staging in a safety requirement in any shop and the one shown in Fig. 8 meets rigid requirements. Some of the other shop kinks not included here are flanging block for syphon diaphragm; heavy gage nickel-content flue safe end; rotary flue bead remover and a method of locating crown sheet.

Notes on Boiler Work

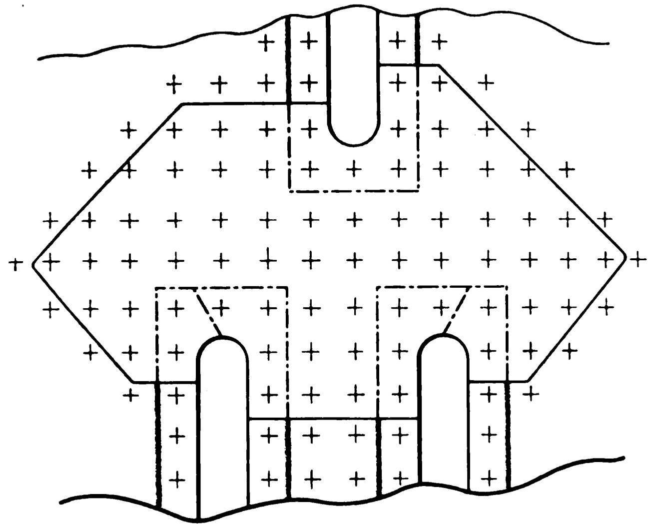
Following is a selection from a group of notes on boiler work that formed part of the report:

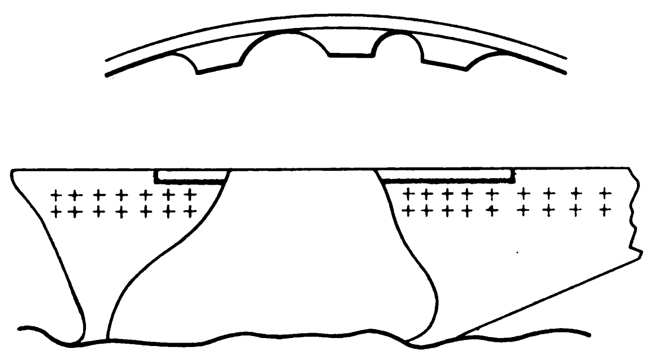
Manufacturing of Boilers

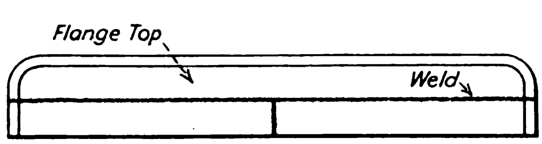
In using alloy steel for boiler courses, the plate should be scalloped at both ends for the proper radius. Sheets should be run through the roller with a slight touch and run in this manner until a true circle is reached.

All plates, making up the seams in boilers, should be fitted metal to metal by using fitting up bolts in every other hole. The open holes are then to be reamed to required size and chamfered slightly inside and outside. Rivets should then be driven in all open holes. The fitting up bolts are next removed, the rest of the holes reamed, chamfered, and rivets driven.

Chamfering should be done on all holes in the boiler in order to prevent cracks developing out of holes with sharp edges. In all cases, where seams or caulking edges are to be sealed by welding, use a flat tool to caulk seams instead of the regular standard type (fuller square tool). It has also been proved that any seam or caulking edge on which a standard type caulking tool has been used has a tendency to lift the edge, thereby forming an opening between rivet hole and edge; the use of a flat tool for caulking does not show this wedge action.

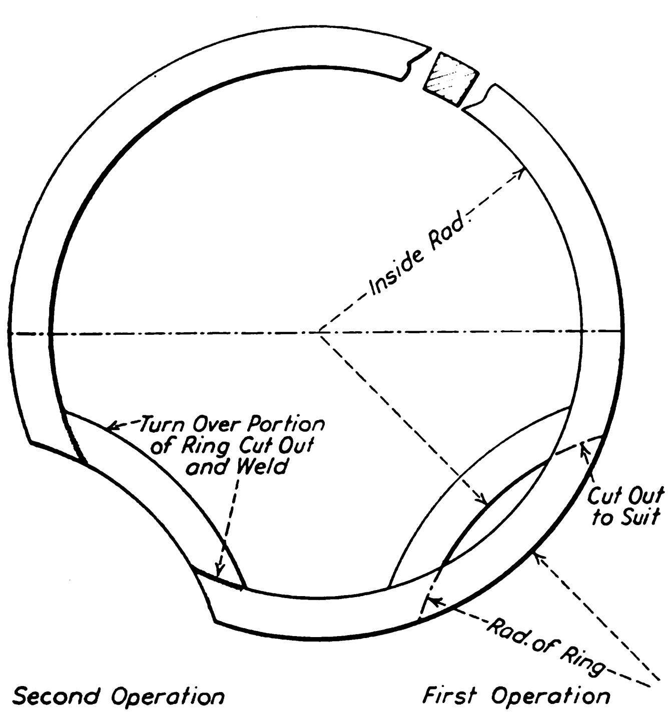






Roll Band to Suit Depth - Join by Welding

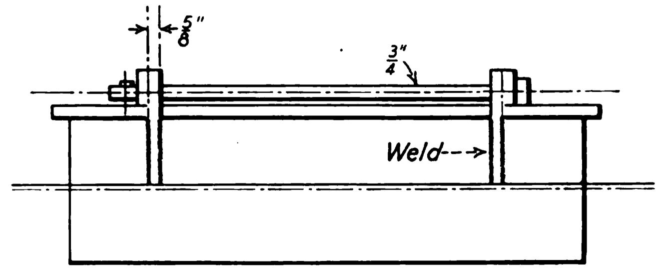
Above: Figs. 1 and 2—Below: Fig. 3



Side Sheets

Many individual solutions to this problem have been advanced from time to time; but it is still one of the most perplexing problems facing the boiler maintainer and is, so far as we can see, still unsolved.

Several papers mention high firing rates which cause a trend toward a high heat-resisting firebox steel. This indicates a step toward a permanent cure.



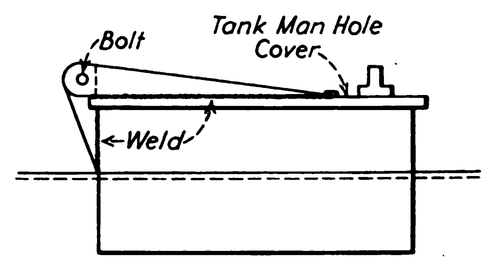


Fig. 4

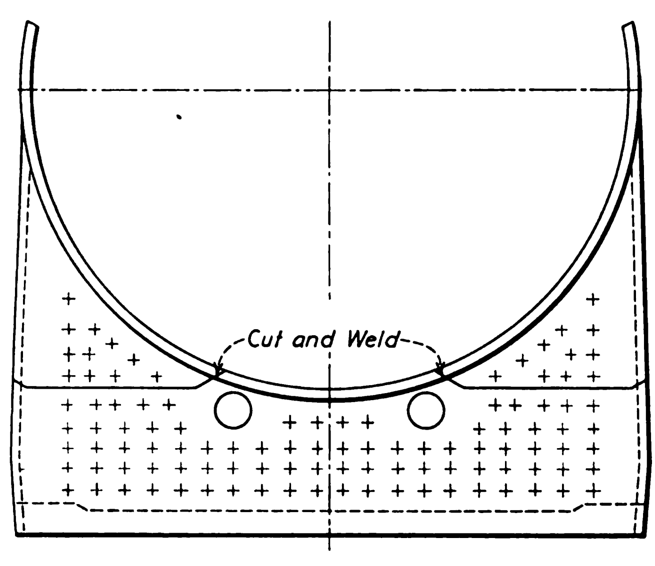


Fig. 5

Gas Welding and Cutting

Among many improved methods, none approached the advantages that have and are being offered by the use of the oxy-acetylene process for the cutting and welding of ferrous, alloys and non-ferrous metals.

A recent innovation is that of a gouging nozzle used for cutting grooves, repairing a plate edge for welding, removing arc welds for renewal, removing welded flue heads, etc.

Stationary automatic shape cutting machines are now an important and necessary part of modern shop equipment. This is not only an aid to increased production but a precision tool which makes for greater accuracy in preparing plate of any prac-

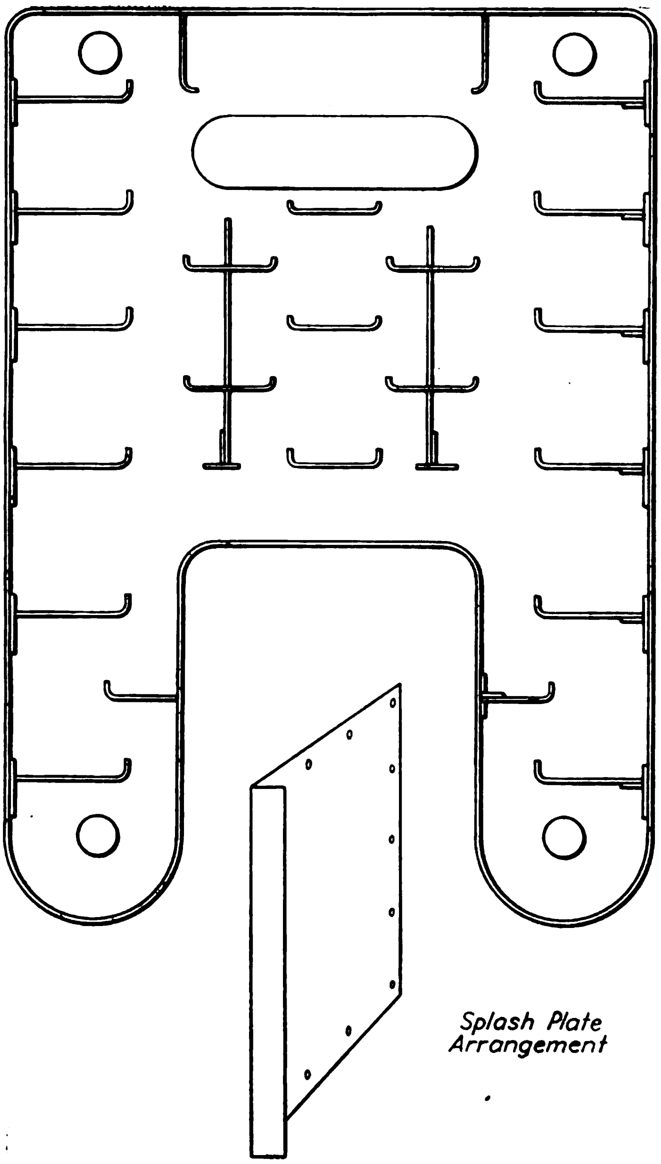


Fig. 6

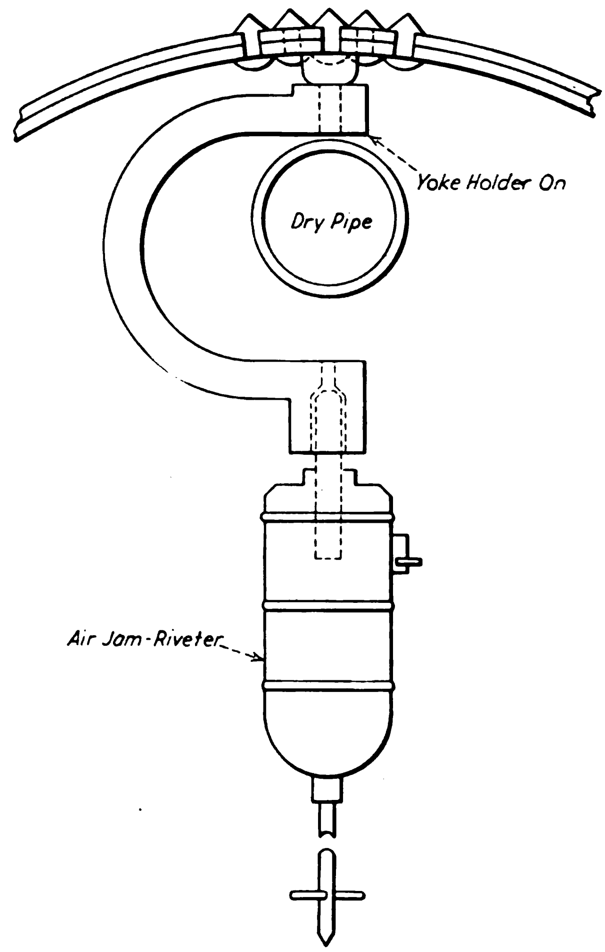


Fig. 7

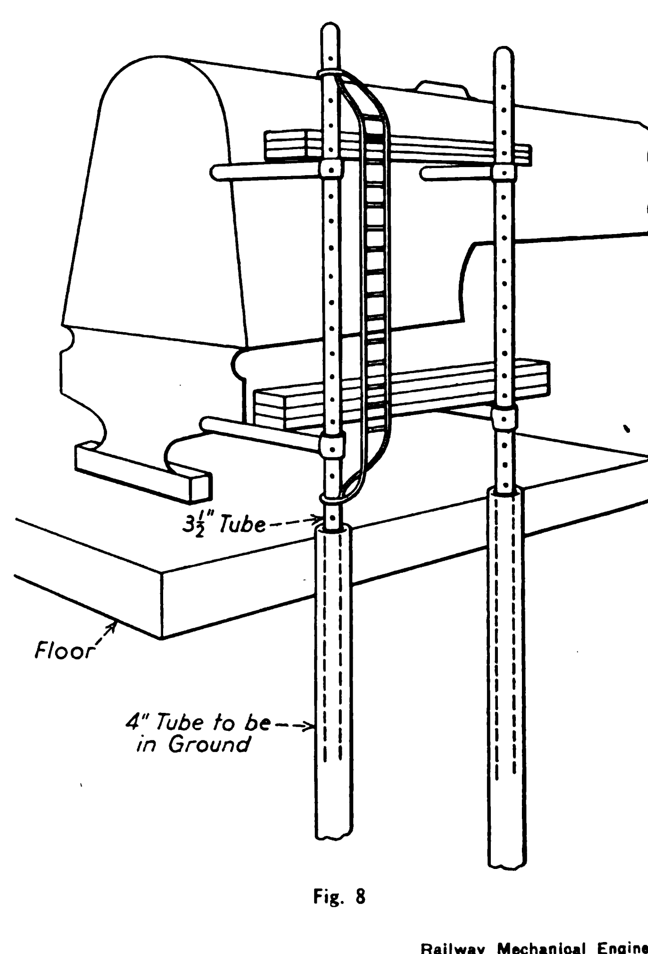


Fig. 8

tical dimension or thickness for assembling and fabrication. Many shops have from 225 to 300 regular operations assigned to such machines.

Multiplicity of parts is accomplished by the attachment of from one to four blowpipes and for the piling of plate where accurate duplication at low cost is a factor. To augment these facilities, portable mechanical driven units are also available and used extensively. Machine cutting caulking edges without subsequent chipping is now standard in many shops.

Special designs of blowpipes are now available for cutting flexible staybolt sleeve openings in wrapper sheets. Adjustment for variable diameters makes possible the cutting of washout plug holes, arch tube plug openings, etc.

The introduction of large gas capacity welding blowpipes facilitates the heating of areas where localized application is important and, therefore, offers many economies in boiler shop work. The flanging of door holes, sharp corner flanges, laying up of sheets, preparation of patches, bending angle iron and other structural shapes with the blowpipe are not uncommon operations.

The report was signed by S. Christopherson (chairman), supervisor boiler inspection and maintenance, N. Y. N. H. & H.; B. C. King, general boiler inspector, N. P.; A. T. Hunter, assistant general boiler inspector, A. T. & S. F.; Frank C. Hasse; J. W. Kennefic, service engineer, Air Reduction Sales Co.; J. F. Becker; E. J. Brennan, general boiler foreman, B. & M.; V. B. Vogel, supervisor of welding, C. R. I. & P.; H. P. Butler, chief boiler inspector, Bangor & Aroostook, and D A. Stark, general boiler and mechanical inspector, L. V.

EDITORIALS

Conventions—Good! But Not Good Enough?

Before the meetings of the four so-called coordinated associations were held at Chicago on September 23 and 24, there was a general feeling of uncertainty as to their success. Many were of the opinion that, under present conditions, the attendance would be light; indeed, there were those who advocated cancelling the meetings. It is true that the registered attendance at the meetings this year was considerably lower than last year, with the exception of the Master Boiler Makers' Association which was appreciably larger.

In appraising the causes for this general reduction in attendance, it must be remembered that last year's meeting had all the stimulus of an extensive exhibit and none of the discouragement of the defeatist psychology engendered this year by those who are normally lukewarm or positively opposed to association activities, and by others who lack the courage of their convictions. The fact that more than 1,000 members and railroad guests of the four associations were in attendance at the two-day meetings is surely evidence of a very wide interest, and that the associations enjoy the support of many American railway managements. As President Raymond said, in opening the first session of The Railway Fuel and Traveling Engineers' Association, such meetings were never of greater importance than under present conditions of stress in the railway industry.

Word has gone out that no meetings of this or any of the other coordinated associations are to be held next year. This is in keeping with the recently announced decision of the Mechanical Division, Association of American Railroads, not to hold a full-membership meeting but to return to the practice of the depression years of convening the committee chairmen with the Executive Committee for the purpose of presenting the reports of the work done by the committees during the year.

In the case of the Mechanical Division, the effect on its work of the cancellation of a full-membership meeting is not serious. With the large and representative membership on most of the committees, the ground has been thoroughly canvassed before the reports are finally presented. Furthermore, final action in the matter of standards or recommended practice is taken by letter ballot after the meeting.

Such is not the case, however, with the voluntary associations of supervisors whose work is not concerned primarily with the development of official standards, but deals in the realm of craftsmanship and the problems of supervision in which personal experience is of great importance.

These associations can make committee assignments and reports can be prepared and distributed to the members in printed form. Indeed, the four associations have already decided to proceed with next year's work on that basis. Fully half of the value of this work will be lost by this procedure, however, because it lies in the give-and-take of opinion brought out in the discussion on the floor as well as in the more intimate exchange of experience and opinion which takes place outside of the meeting rooms.

It is unfortunate that the Mechanical Division has chosen to discourage meetings of these organizations. The value which comes to the members through these exchanges, as well as through the intangible spur to the will to greater accomplishment, otherwise called inspiration, will be sorely needed by the railroads next year—and every year.

Three Mechanical Officers On Association Work

It should be highly encouraging to the men who have given liberally of their own time and energy to keep the work of the so-called Co-ordinated Associations going and to improve its quality that the value of their efforts are not without understanding and appreciation on the part of the heads of the mechanical departments of some of the large railway systems. Witness the remarks made by three of them before the recent meeting of the Car Department Officers' Association at Chicago.

E. B. Hall, chief mechanical officer, C. & N. W., and a member of the Mechanical Division, General Committee, referred to the difficulty in securing working committees and competent chairmen, without whom the activities of any group such as the Car Department Officers' Association are essentially curtailed and crippled. He said: "I have arrived at the conclusion, which to some extent may be an admission on my part, that the remedy for this lies largely in the hands of mechanical department heads. More car- and locomotive-department officers must be given permission to attend conventions of this character. Men selected for committee work must be given to understand that their supervisors encourage and support activity of this nature. That they be given full release from their railroad assignments to attend committee meetings when called is evidently very necessary. In other words, a more tolerant and co-operative spirit toward associa-

tion work on the part of mechanical-department heads is necessary. You may rest assured that I will do everything within my power to accomplish that result."

In concluding his address, D. S. Ellis, chief mechanical officer, C. & O., and also a member of the Mechanical Division General Committee, said, "I wish to congratulate President Krueger and the entire membership of this association on the excellent work you are doing . . . I wish you every success and express the fond hope that we all may never grow too old to learn."

K. F. Nystrom, mechanical assistant to the chief operating officer, C. M. St. P. & P., and past president of the Car Department Officers' Association, recalled the days when the Association was struggling for existence and said it was a great satisfaction to him personally to see such a successful meeting of an association which the railroad he represents is standing behind and expects to continue to support wholeheartedly.

Association Work—A Task Or A Personal Opportunity?

When a man is placed in a position of responsibility his obligation, both to himself and to the industry in which he serves, increases in proportion. The experience he gains in carrying on his daily work equips him for greater responsibility but involves him in a situation wherein he must continually look to many other sources than his immediate surroundings and associates for the knowledge he requires for the successful conduct of his job. Fortunately his own work provides him with a valuable asset which he can trade with other men in the same industry and in the process both the individuals and the industry profit.

No one with any breadth of vision would discount the work of an association as a means of extending the knowledge and experience of men in industry to all others in the same field of endeavor, but there seem to be many who do not fully appreciate the potential value of an affiliation with an organization the purpose of which is to promote the best interests of those within that organization and the industry which it serves.

What this value is and the manner in which it may be extended to the individual was rather well summed up by J. C. Miller, retiring president of the Locomotive Maintenance Officers' Association when, in addressing the membership, he said: "There is real need in organizations such as ours for painstaking study and investigation which can best be accomplished by committees made up of men from various sections of the country who work under a variety of conditions. The gathering and assembling of material in a report is in itself a challenge to the thinking and better performance of those who take part in the project, and when the report is finally discussed by the association and disseminated it is a practical and substantial contribution to the entire membership.

"It is not an easy task to perform successful committee work. Techniques must be developed, unless men are available who have had considerable experience in working on committees for other organizations. Unfortunately the 'lean thirties' deprived most of our members of such experiences. We have a lot to learn in this respect. We may have deliberately to seek for men as new members who can be helpful in this way. If we are alert and open minded and seriously study how to make committee work more effective we can overcome the handicap.

"The reports presented at this meeting . . . are not a 100 per cent job. They are, however, the foundation of something that can be built into an invaluable structure in the years to come. They represent the medium through which data on the variety of practices involved in repairing locomotives can be co-ordinated and presented to the industry in a manner that it can be used to advantage. There is no better way in which the ideas of practical men can be brought together and made available to all."

There, in a few words, is a plain statement concerning what an association can accomplish accompanied by specific suggestions as to how it may be done and the value that may be expected to accrue as a result.

At this moment, with a year of convention work fresh in the minds of all association officers and committee chairmen, there are many who have been charged with the responsibility of bringing a convention program to a successful conclusion who may be very much inclined to feel that it has not been worth the effort. Why do they feel that way about it? In the answer to this question may be a clue to a weakness of some associations.

In order to carry on constructive committee work, particularly with respect to technical subjects, an association's several committees should have an element of permanence as regards personnel—permanence in the sense that the make-up of a committee should be such that there may always be some members with one or more years experience in committee work. It is upon these experienced men that the association must rely to carry on the work of that committee in accordance with the established policies of the organization and in a manner that will produce the type of final report that will be of maximum value to the people in the industry who hope to add to their knowledge by the use of the report. It is not a difficult matter for railroad supervisors to sit down, in some moment when the demands for more, and still more, locomotives and cars is not too pressing, and analyze carefully the proceedings of their favorite association and decide for themselves whether or not the material they have before them is of real value to them in their work. Nine times out of ten the answer may be that the report they have under consideration is lacking in some important respect—it may be that important data is missing; that a line of investigation was not followed, by the committee, to a logical conclusion or that the information at the committee's dis-

(*Continued on next left-hand page*)

posal was not organized and presented in a manner to be readily understandable.

If the job done by the committee fails to measure up to your specifications there lies your obligation and your opportunity. Exercise your right as a member to insist on a better job being done and demonstrate your sincerity by putting your shoulder to the wheel when asked to help. The experience you get will fit you for greater responsibility.

Priorities Have Outlived Their Usefulness

The present system of priorities has outlived its usefulness. Originally intended for application to a limited list of critical materials, against civilian demands for which strictly defense products had to be protected, the situation has rapidly advanced to a point where a tremendous list of materials essential alike to the continued functioning of our industrial machine as well as to the output of strictly defense products are under priority control.

The effect of this control is highly detrimental to railway transportation. The delivery of cars has fallen behind the needs of the railroads during the current year and prospects for future deliveries are so discouraging at the present time that the placing of orders has almost ceased.

Few machine tools are used directly by military forces. The reason for priority protection of the machine-tool industry during past months lay in the need for machine tools to equip the new plants required to produce the tremendously expanded volume of defense products demanded by the national government. Transportation is as essential a part of our national establishment for the production of defense equipment and materials as are the industries whose products are ordered directly by the military departments of the national government, which is only another way of saying that locomotives and cars are of equal importance with machine tools.

A failure of transportation because the railways have been unable to expand their supply of equipment sufficiently to meet the tremendous increase in traffic, present and prospective, will cause just as complete a failure of the national effort to carry out the defense program as will a direct failure of any of the plants producing them, to meet the planned outputs of airplanes, tanks, guns, shells, or ships.

Until the minimum current needs for expanded facilities of transportation as well as of other essential industries are taken into account as of equal importance with the needs for strictly defense products, the government allocation of materials is based upon unreality. The railroads, as well as other essential links in the chain of our national productive establishment, must be accorded their share of all essential materials currently without any question of priority. Only thus can the establishment be kept in a state of balance by which the greatest output of defense materials can be produced—and delivered where they can be used.

New Books

PROCEEDINGS OF THE 1940 ANNUAL MEETING OF THE CAR DEPARTMENT OFFICERS' ASSOCIATION. *F. L. Kartheiser, Secretary-Treasurer, Chief Clerk, Mechanical Department, C. B. & Q., Chicago. 288 pages, Price, $3.*

This book contains the full proceedings of the 1940 annual meeting of the Car Department Officers' Association held at Hotel Sherman, Chicago, October 22 to 25 of last year. Included in the proceedings are two addresses made by railroad officers on the subject of car maintenance and eight technical committee reports. The technical reports are included in detail, with the discussion by the members, and cover the following subjects: Freight and passenger car maintenance; shop operation, facilities and welding; terminal handling of passenger train cars and air conditioning; inspection of freight cars and their preparation for commodity loading; interchange and billing for car repairs; loading rules and painting. The book also contains a directory of the membership.

MACHINE SHOP TRAINING COURSE—*Second Edition. By Franklin D. Jones. Two volumes, 6 by 9 inches. Volume 1, 538 pages, 334 illustrations; Volume 2, 552 pages, 209 illustrations. Published by The Industrial Press, 148 Lafayette St., New York City. Price, complete two-volume course, $6; Volume 1 or 2, if purchased separately, $4.*

This second edition of Machine Shop Training Course is practically the same as the first edition with the exception of some additional matter of considerable importance to many students of machine shop practice. This two-volume treatise—which is especially designed for shop courses, technical trade schools, and also for self-instruction—now has, as one extra feature, an original series of blueprint reading charts. This series of twenty-nine full-page charts, all in color, shows by a simple progressive method just how to read or understand mechanical drawings. Each chart consists of from two to five drawings especially selected to illustrate, step by step, the fundamental principles underlying blueprint reading.

These charts are supplemented by a series explaining the meanings of various standard abbreviations or symbols. Typical applications of these abbreviations or symbols are illustrated in all cases by means of detail drawings. American Standard screw thread symbols, as well as standard cross-section lines for different materials, are included in this series.

Another feature of the second edition is a chapter on "Engineering Standards Applied in Machine Building." The purpose of this chapter is to give information that will be useful not only in shop work but also in the reading of mechanical drawings.

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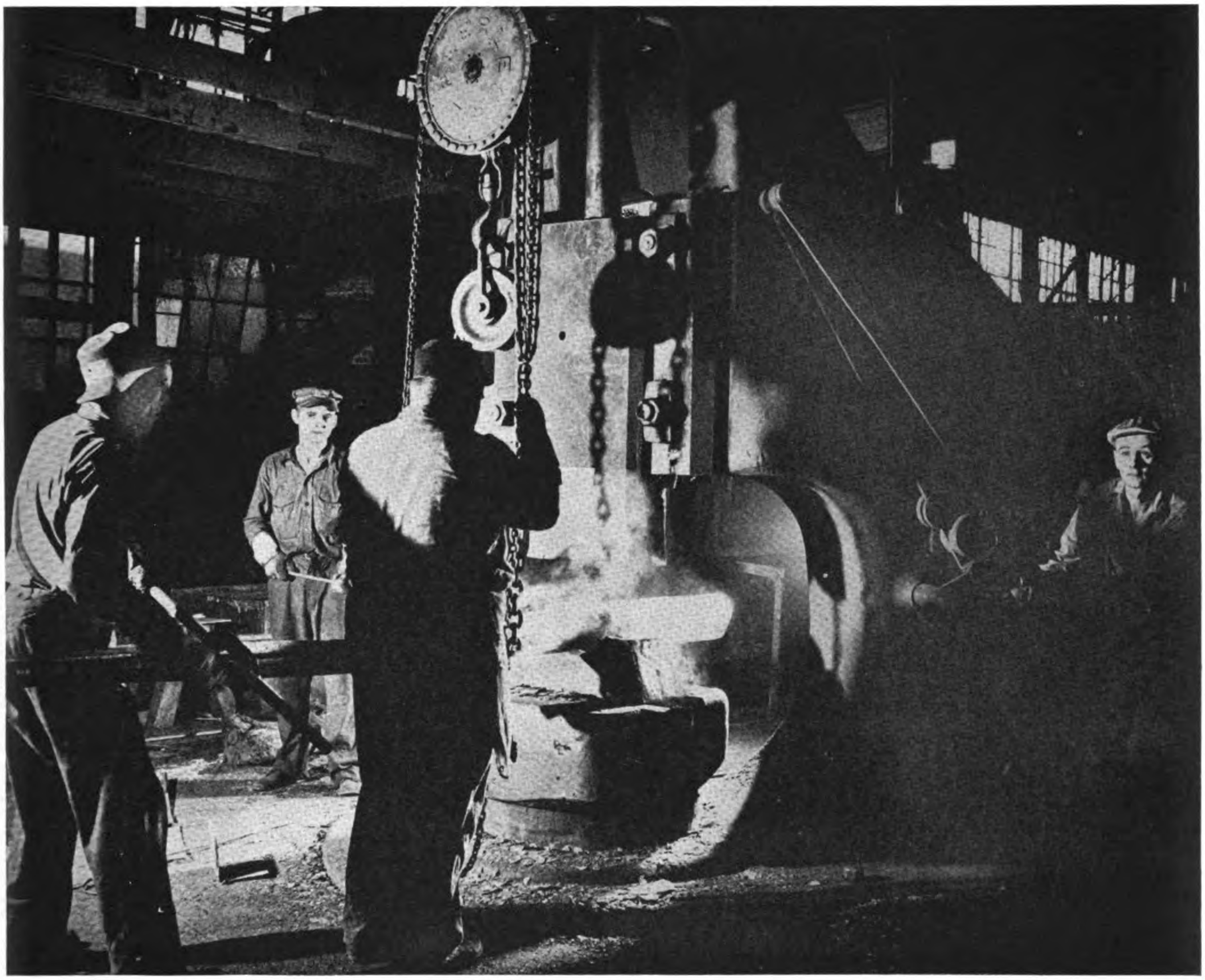
From a white hot billet . . . To a cold steel rod

LIMA QUALITY IS "POUNDED-IN" EVERY STEP OF THE WAY



From the time a potential Lima piston rod leaves the heating furnace until it is placed on a locomotive "ready for service", it undergoes the rigid tests for quality and tolerances that have earned for Lima its reputation as a builder of high-performance, low-maintenance locomotives. The illustration above is a typical scene at Lima showing the first step in fabricating a "Lima Quality" Piston Rod.

LIMA LOCOMOTIVE WORKS — LIMA LOCOMOTIVE WORKS INCORPORATED — INCORPORATED, LIMA, OHIO

High Spots in
Railway Affairs . . .

Emergency Board At Work

The Emergency Board in the railway wage controversy announced at the outset of the hearings on September 16 that it could not complete the hearings and make its report to the President within 30 days. At its request the President granted an extension of time to November 1. The formal hearings will extend beyond the middle of this month. The Board's problem is complicated by the fact that it must not only consider the demands of the operating and non-operating employees, but it has also taken jurisdiction in the Railway Express controversy, because of a threatened strike of those employees on September 13. The order in which the evidence will be presented follows: (1) Non-operating employees' vacation and wage demand; (2) operating employees' wage demand; (3) railways' reply to these demands; (4) carriers' proposal to change working rules; (5) employees' reply; (6) express employees' demand; (7) Express Company's reply. Thirty days must elapse after the report is made to the President before either side in the controversy can take action.

Emergency Board Chairman

What sort of man heads up the Emergency Board? Since 1938 Wayne Lyman Morse, dean of the law school, University of Oregon, has functioned with signal success as a United States Department of Labor arbitrator, with the task of interpreting and enforcing the master agreement which governs the relations between longshoremen and ship operators on the Pacific Coast. Recently he has served as a "public" member of two industry committees set up by the Department of Labor's Wage and Hour Division, to determine minimum wages under the provisions of the Fair Labor Standards Act. Native of Madison, Wis., 41 years of age, a graduate of the University of Wisconsin, he took his law course at the University of Minnesota and did graduate work at Columbia University.

Other Emergency Board Members

The Emergency Board, of which Dean Morse is chairman, has four other members. James Cummings Bonbright, professor of finance at Columbia University, is the author of books on railroad capitalization, holding companies and utility valuation. Since 1939 he has been chairman of the Power Authority of the State of New York, which favors public ownership and development of power resources and is for the St. Lawrence seaway and power project. Native of Evanston, Ill., about 50 years of age, Dr. Bonbright is a graduate of Northwestern University and has a Ph. D. degree from Columbia University. Thomas Reed Powell, professor of law at Harvard Law School, has been a law teacher and law lecturer at various colleges. He is the author of several books on political subjects and during 1936 was special assistant to the United States Attorney General. Born at Rockford, Vt., he is 61 years old. He is a graduate of the University of Vermont and received his LL. B. degree from Harvard Law School. Huston Thompson, attorney, Washington, D. C., is the one member of the board who has had previous Emergency Board experience. He was chairman of a three-man board which considered the wage demands of the Atlanta, Birmingham & Coast train and yard service employees early this year. He served a term on the Federal Trade Commission. Born in Lewisburg, Pa., and 66 years old, he is a graduate of Princeton University. He studied law at the New York Law School. Joseph Henry Willits, director for social science, Rockefeller Foundation, has had a long record in the field of social service and labor relations. Prior to joining the Rockefeller Foundation he was dean of the Wharton School of Finance and Commerce of the University of Pennsylvania for several years. Born in Ward, Pa., and 52 years of age, he is a graduate of Swarthmore College.

Railroad Workers' Wages

There are several methods of calculating the average wage of railroad workers, but because of the conflicting interests involved, there apparently always will be differences of opinion as to just which one is most equitable. The Railroad Retirement Board, as an example, has made a compilation showing that, considering all railroad employees, including 102,388 who had worked in only one month of the year, and 129,927 who had earned less than $50. during the year, the average 1939 wage was $1,324. Obviously there were included in this compilation thousands and thousands of workers who could in no sense be regarded as regular railway employees. The Railroad Retirement Board in another calculation found that 862,153 employees had done some work on the railroad in each month in 1939, and that the average earnings of this group amounted to $1,844. These figures, incidentally, exclude pay in excess of $300. a month. The Bureau of Statistics of the Interstate Commerce Commission has approached the problem in still another way. Its compilation is based on average compensation for the mid-month count of employees and amounts to $1,839, or a little lower than the $1,844 figure of the Retirement Board.

Transport Study Board Gets Started

The Transportation Act, which was finally passed and approved by the President in September, 1940, called for the establishment of a Board of Investigation and Research, to make a thorough study of the transportation system in this country, and make recommendations as to how the various types of carriers might best be developed in the public interest. Because of the delay in appointing the board, it was impossible for it to make a preliminary report on or before May 1, 1941, as called for in the Act. As a matter of fact, the three members of the board did not take the oath of office until August 22, and so were hard put to it to prepare an annual report. The board is attempting to gather the necessary information, with the co-operation of private and governmental agencies, and thus to avoid unnecessary and wasteful duplication of effort. While $100,000 was appropriated for the board's work, it plans, after it has more thoroughly explored the situation, to ask for additional funds "to enable it to function effectively." Its offices are in the Dupont Circle Apartments Building, Washington, D. C.

Calls on Shippers For Co-operation

Ralph Budd, defense transportation commissioner, recently pointed out that the difficulty in obtaining materials for the building of new railroad equipment had resulted in a lagging in the car building program, to the extent that 20,000 less new cars were in service on October 1 than provided for by the railroads. He made a special appeal to the president of the National Association of Advisory Boards and the president of the National Industrial Traffic League for cooperation on the part of the shippers. Mr. Budd pointed out that "the important part which shippers and receivers play in efficient utilization of freight cars has long been recognized." He said also, "During the next several weeks, in order that everyone desiring transportation service may receive it currently without delay, new records in the volume of transportation rendered per unit of serviceable equipment must be made. This appeal to all users of transportation to renew during the coming weeks their previous efforts to eliminate all wasteful use of transportation, and particularly to urge all to do everything in their power to prevent delay to cars while awaiting loading or unloading, is made in the interest of the general welfare. A few hours and a few dollars spent in loading or unloading cars seven days a week or after usual closing time may well pay large dividends to the shippers directly involved, and to the country as a whole."

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Provide better combustion
In the 20 New
UNION
PACIFIC
4-8-8-4's
Improved Arch Support for the largest fireboxes
★
Adapted to any type of locomotive
★
Reduced honeycombing, flue plugging and cinder cutting
★
Improved circulation in side water legs
An interior view of the firebox of one of the 4-8-8-4 Union Pacific Mallets showing the positioning of the seven Security Circulators in the firebox.
COMPANY, INC.
NEW YORK
CHICAGO

Among the Clubs and Associations

CAR DEPARTMENT ASSOCIATION OF ST. LOUIS.—Meeting October 21 at 8 p. m. at Hotel DeSoto, St. Louis, Mo. Subject: Roller Bearings—Their Installation and Maintenance. Speaker: Paul N. Wilson, sales engineer, Railway Division, Timken Roller Bearing Company.

EASTERN CAR FOREMEN'S ASSOCIATION.—Meeting 8 p. m., October 10, Engineering Societies building, New York. Speaker: Charles R. Busch, vice-president, Unit Truck Corporation. Subject: Unit Trucks, with slides illustrating mechanics and handling of the unit truck.

W. H. Winterrowd and C. B. Peck Elected A. S. M. E. Vice-Presidents

W. H. Winterrowd, vice-president of the Baldwin Locomotive Works, Eddystone, Pa., and C. B. Peck, managing editor of "Railway Mechanical Engineer and mechanical department editor of *Railway Age*, New York, were among four elected vice-presidents of the American Society of Mechanical Engineers by a letter ballot of its 15,000 members, the results of which were announced recently. Elected president of the society was J. W. Parker, vice-president and chief engineer of the Detroit Edison Company. Other vice-presidents elected were C. F. Freeman, senior vice-president and engineer, Manufacturers Mutual Fire Insurance Company, Providence, R. I., and W. R. Woolrich, dean of the College of Engineering, University of Texas, Austin, Tex.

Mr. Winterrowd was born at Hope, Ind., on April 2, 1884, and was graduated from Purdue University with the degree of B. S. in M. E. in 1907, receiving his doctorate degree in 1936. He entered railroad service in 1905 as a blacksmith's helper on the Lake Erie & Western (now New York, Chicago & St. Louis) at Lima, Ohio, and in 1906 became car and air brake repairman for the Pennsylvania, Lines West of Pittsburgh, at Dennison, Ohio. A year later he became special apprentice for the Lake Shore & Michigan Southern (now New York Central). In 1908 Mr. Winterrowd went with the Lake Erie, Alliance & Wheeling (now New York Central) as enginehouse foreman, becoming night enginehouse foreman at Youngstown, Ohio, for the Lake Shore & Michigan Southern the following year. He then served with the latter road as roundhouse foreman at Cleveland, Ohio, and assistant to mechanical engineer, successively. From 1912 to 1918 he was mechanical engineer for the Canadian Pacific, and from 1918 to 1923, chief mechanical engineer of that road. He was assistant to president of the Lima Locomotive Works at New York from 1923 to 1927, when he became vice-president of that company. In 1934 he became vice-president of the Franklin Railway Supply Company at Chicago, the position he held until 1939 when he became vice-president in charge of operations of the Baldwin Locomotive Company.

Mr. Peck was born at Pierson, Mich., on June 24, 1884, and was graduated from Michigan Agricultural College with the degree of B. S. in M. E. in 1907. He entered railroad service in 1907 as draftsman on the Duluth, South Shore & Atlantic at Marquette, Mich., holding this position until 1911. From the latter year until 1914 he was assigned to special duties in the mechanical engineer's office of the Atchison, Topeka & Santa Fe at Topeka, Kan. From 1914 to 1919 Mr. Peck was associate editor, Mechanical edition, Railway Age Gazette, New York, and from 1919 to 1923 served as Western mechanical editor of Railway Age and "Railway Mechanical Engineer" at Chicago. In 1923 Mr. Peck became managing editor, *Railway Mechanical Engineer* and mechanical department editor, Railway Age.

DIRECTORY

The following list gives names of secretaries, dates of next regular meetings, and places of meetings of mechanical associations and railroad clubs:

ALLIED RAILWAY SUPPLY ASSOCIATION.—J. F. Gettrust, P. O. Box 5522, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—C. E. Davies, 29 West Thirty-ninth street, New York.
RAILROAD DIVISION—C. L. Combes, *Railway Mechanical Engineer*, 30 Church street, New York City.
MACHINE SHOP PRACTICE DIVISION.—Warner Seely, Warner & Swasey Co., 5701 Carnegie avenue, Cleveland, Ohio.
MATERIALS HANDLING DIVISION. — F. J. Shepard, Jr., Lewis-Shepard Co., Watertown Station, Boston, Mass.
OIL AND GAS POWER DIVISION.—L. N. Rawley, Jr., Power, 330 West Forty-second street, New York.
FUELS DIVISION.—D. C. Weeks, Consolidated Edison Co., 4 Irving Place, New York.

ANTHRACITE VALLEY CAR FOREMEN'S ASSN.—Exec. sec., Walter B. Riggin, 215 Swartz street, Dunmore, Pa. Meets third Monday of each month at Wilkes-Barre, Pa.

ASSOCIATION OF AMERICAN RAILROADS.—Charles H. Buford, vice-president Operations and Maintenance Department, Transportation Building, Washington, D. C.
OPERATING SECTION.—J. C. Caviston, 30 Vesey street, New York.
MECHANICAL DIVISION.—A. C. Browning, 59 East Van Buren street, Chicago.
PURCHASES AND STORES DIVISION.—W. J. Farrell, 30 Vesey street, New York.
MOTOR TRANSPORT DIVISION.—George M. Campbell, Transportation Building, Washington, D. C.

CANADIAN RAILWAY CLUB.—C. R. Crook, 4415 Marcil avenue, N. D. G., Montreal, Que. Regular meetings, second Monday of each month, except June, July and August, at Windsor Hotel, Montreal, Que.

CAR DEPARTMENT ASSOCIATION OF ST. LOUIS.—J. J. Sheehan, 1101 Missouri Pacific Bldg., St. Louis, Mo. Regular monthly meetings third Tuesday of each month, except June, July and August, DeSoto Hotel, St. Louis.

CAR DEPARTMENT OFFICERS' ASSOCIATION.—Frank Kartheiser, chief clerk, Mechanical Dept., C. B. & Q., Chicago. Annual meeting, Hotel Sherman, Chicago, September 23 and 24.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—G. K. Oliver, 8238 S. Campbell avenue, Chicago. Regular meetings, second Monday in each month, except June, July and August, La Salle Hotel, Chicago.

CAR FOREMEN'S ASSOCIATION OF OMAHA, COUNCIL BLUFFS AND SOUTH OMAHA INTERCHANGE.—H. E. Moran, Chicago Great Western, Council Bluffs, Ia. Regular meetings, second Thursday of each month.

CENTRAL RAILWAY CLUB OF BUFFALO.—Mrs. M. D. Reed, Room 1840-2, Hotel Statler, Buffalo, N. Y. Regular meetings, second Thursday of each month, except June, July and August, at Hotel Statler, Buffalo.

EASTERN CAR FOREMAN'S ASSOCIATION.—W. P. Dizard, 30 Church street, New York. Regular meetings, second Friday of January, February (annual dinner), March, April, May, October, and November at Engineering Societies Bldg., 29 West Thirty-ninth street, New York.

INDIANAPOLIS CAR INSPECTION ASSOCIATION.—R. A. Singleton, 822 Big Four Building, Indianapolis, Ind. Regular meetings, first Monday of each month, except July, August and September, in Indianapolis Union Station, Indianapolis, at 7 p. m.

LOCOMOTIVE MAINTENANCE OFFICERS' ASSOCIATION.—J. E. Goodwin vice-president, secretary-treasurer, c/o Missouri Pacific, North Little Rock, Ark. Meeting September 23 and 24, Hotel Sherman, Chicago.

MASTER BOILER MAKERS' ASSOCIATION.—A. F. Stiglmeier, secretary, 29 Parkwood street, Albany, N. Y. Annual meeting, Hotel Sherman, Chicago, September 23 and 24.

MID-WEST AIR BRAKE CLUB.—C. F. Davidson, secretary-treasurer, general inspector car department, St. L.-S. F., Springfield, Mo.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic avenue, Boston, Mass. Regular meetings, second Tuesday in each month, except June, July, August and September.

NEW YORK RAILROAD CLUB.—D. W. Pye, Room 527, 30 Church street, New York. Meetings, third Thursday in each month, except June, July, August, September and December at 29 West Thirty-ninth street, New York.

NORTHWEST CAR MEN'S ASSOCIATION. — E. N. Myers, chief interchange inspector, Minnesota Transfer Railway, St. Paul, Minn. Meetings first Monday each month, except June, July and August, at Midway Club rooms, 1931 University avenue, St. Paul.

NORTHWEST LOCOMOTIVE ASSOCIATION.—G. T. Gardell, 820 Northern Pacific Building, St. Paul, Minn. Meetings third Monday of each month, except June, July and August.

PACIFIC RAILWAY CLUB.—William S. Wollner, P. O. Box 3275, San Francisco, Cal. Monthly meetings alternately in northern and southern California.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 1647 Oliver Building, Pittsburgh, Pa. Regular meetings, fourth Thursday in month, except June, July and August, Fort Pitt Hotel, Pittsburgh, Pa.

RAILWAY FUEL AND TRAVELING ENGINEERS' ASSOCIATION.—T. Duff Smith, Room 811, Utilities Building, 327 South La Salle street, Chicago. Annual meeting Hotel Sherman, Chicago, September 23 and 24, 1941.

RAILWAY SUPPLY MANUFACTURERS' ASSOCIATION.—J. D. Conway, 1941 Oliver Building, Pittsburgh, Pa.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.—A. T. Miller, P. O. Box 1205, Atlanta, Ga. Regular meetings, third Thursday in January, March, May, July and September. Annual meeting, third Thursday in November, Ansley Hotel, Atlanta, Ga.

TORONTO RAILWAY CLUB.—D. M. George, Box 8, Terminal A, Toronto, Ont. Meetings, fourth Monday of each month, except June, July and August, at Royal York Hotel, Toronto.

WESTERN RAILWAY CLUB.—E. E. Thulin, executive secretary, Room 822, 310 South Michigan avenue, Chicago. Regular meetings, third Monday in each month, except June, July, August, September, and January.

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NEWS

Couplers With Burned Out Key Slots

EFFECTIVE August 1, 1941, the A. A. R. Mechanical Division added a new Par. 2 to Sec. C of Interchange Rule 18, which not only prohibits the burning out of key slots in any type of coupler body but requires the removal of any such couplers found in service at the expense of the car owner. Due to the present emergency in the matter of obtaining car repair materials, the second part of this new rule requiring the removal of couplers found in service with burned out key slots has been made non-effective as of September 1, the understanding being that the rule will be reinstated when conditions warrant.

Movie Night at Meeting of Co-ordinated Mechanical Associations

ON Tuesday evening, September 23, during the annual meetings of the Car Department Officers' Association, the Railway Fuel and Traveling Engineers' Association, the Master Boiler Makers' Association, and the Locomotive Maintenance Officers' Association, there was a showing of moving pictures and slides for the members and guests of the four associations. A film entitled "The Power Behind the Nation," contributed by the Norfolk & Western, illustrated the production and handling of coal from the mine to the hold of the ship at tidewater. One of two films of the United States Treasury Department dealt with the detection of counterfeit money; the other urged the purchase of Defense Savings bonds. There were also two series of lantern slides. One, contributed by the Hartford Steam Boiler Inspection & Insurance Company, showed stress concentrations in various types of welded joints by means of polarized light. The other, illustrating the effect of a case of extremely low water on a water-tube locomotive firebox, was presented by the Baltimore & Ohio. There was no serious damage to the firebox and there were no casualties.

Cars for Loading

IN a letter dated September 5, the secretary of the A. A. R. Mechanical Division called attention to complaints about the loading of unfit cars which has necessitated the stopping of these cars enroute and, in numerous cases, transferring the loads with attendant delays to important shipments, including some urgently needed for the national defense program. The secretary requested that all railroads take such action as may be necessary to assure the selection of cars for loading which may reasonably be expected to proceed to destination without delay enroute for repairs or transfer of the loads.

Particular attention is directed in the secretary's letter to the necessity of maintaining brake beam hangers, pins and other attachments in a proper state of repair at all times, and particularly prior to placing cars for loading, as the failures of these items are frequently the cause of delays to loaded cars enroute. To minimize the seriousness of delays from this cause, it is urged that car owners expedite the application of bottom rod and brake beam safety supports on existing cars in conformity with the requirements of Par. 8, Sec. B, Interchange Rule 3, and also repair or renew such devices previously applied when they are found to be defective, loose or missing on cars when on repair tracks for any reason. Such devices on foreign cars should also be repaired or renewed if proper material is available, but the release of serviceable foreign cars should not be delayed to obtain special materials from the car owner.

J. J. Tatum

ON September 17, J. J. Tatum, assistant chief of motive power and equipment, celebrated his seventy-fifth birthday, as well as his sixty-second year of consecutive service with the Baltimore & Ohio. Mr. Tatum entered railway service in 1879 as a messenger boy at the Mt. Clare, Md., shops of the Baltimore & Ohio. He has taken out 64 patents and eight copyrights for improvements to railroad equipment, and was among those who in February, 1940, were recipients of a Modern Pioneer Award from the National Association of Manufacturers.

J. J. Tatum

Mr. Tatum supervised the building of the Adams "Windsplitter" train at the Mt. Clare shops. It was completed May, 1900, and was fitted with "shields and other devices for reducing the resistance of the air at high speed." The train consisted of five cars drawn by a standard locomotive. The tender, however, was built up to the height of the cars, so that there was no break between the engine cab and the baggage car. It is regarded somewhat as a forerunner of the modern streamliner.

Mr. Tatum was elected chairman of the Mechanical Division, A. R. A., in June, 1924. A talk made by him at about that time received widespread attention in the press, because of its novel suggestions of improvements to passenger carrying cars, including air conditioning. A few years later, in 1930, the Baltimore & Ohio air-conditioned dining car, Martha Washington, was exhibited at the Atlantic City conventions.

Five Experimental Tank Cars for A. C. F.

THE American Car & Foundry Company has been authorized by the Interstate Commerce Commission in an August 19 decision by Commissioner Johnson, to construct five riveted aluminum alloy tank cars for experimental service in the transportation of ninety-five per cent nitric acid.

Budd Names Committee to work With SPAB and OPM

RALPH BUDD, defense transportation commissioner, on September 18, announced the appointment of two committees to represent his office in working with the Supply Priorities and Allocations Board and the Office of Production Management on matters relating to the supply of materials required for construction of railroad freight cars and steam locomotives. The membership of the committee is:

COMMITTEE FOR THE CAR BUILDING INDUSTRY

C. A. Liddle, president, Pullman-Standard Car Manufacturing Co., Chicago.
C. J. Hardy, president, American Car and Foundry Company, New York.
Lester N. Selig, president, General American Transportation Corp., Chicago.
Edwin Hodge, Jr., president, Greenville Steel Car Company, Greenville, Pa.
A. Van Hassel, president, Magor Car Corporation, Passaic, N. J.
F. A. Livingston, president, Ralston Steel Car Company, East Columbus, Ohio.
J. F. MacEnulty, president, Pressed Steel Car Company, Pittsburgh, Pa.

COMMITTEE FOR THE STEAM LOCOMOTIVE INDUSTRY

W. K. Farrell, general purchasing agent, American Locomotive Company, New York.
W. H. Harman, vice-president, Baldwin Locomotive Works, Philadelphia, Pa.
L. A. Larsen, vice-president, Lima Locomotive Works, Inc., Lima, Ohio.
G. W. Alcock, secretary, Locomotive Institute, New York.

Orders and Inquiries for New Equipment Placed Since the Closing of the September Issue

Locomotives

Road	No. of Locos.	Types of Locos.	Builder
Alabama Drydock & Ship Bldg. Co.	2	20-ton Diesel hydraulic	Whitcomb Loco. Co.
Aluminum Ore Co.	1	25-ton Diesel hydraulic	Whitcomb Loco. Co.
Arundel Corp. & Con. Engrg. Co.	10	30-ton Diesel hydraulic	Whitcomb Loco. Co.
Baker Co., J. E.	1	20-ton Diesel hydraulic	Whitcomb Loco. Co.
Bethlehem Steel Co.	5	50-ton Diesel-elec.	Whitcomb Loco. Co.
Chicago & North Western	1	80-ton Diesel-elec.	Whitcomb Loco. Co.
Crucible Steel Company	1[1]	65-ton fireless steam	H. K. Porter Co.
General Supply Co. of Canada	1	30-ton Diesel hydraulic	Whitcomb Loco. Co.
Louisiana Shipyards, Inc.	1	20-ton Diesel hydraulic	Whitcomb Loco. Co.
Louisiana Southern	1	45-ton Diesel-elec.	General Elec. Co.
National Railways of Mexico	2	44-ton Diesel-elec.	General Elec. Co.
Norton Company	1	75-ton fireless steam	H. K. Porter Co.
Pennsylvania Power & Light Co.	1[2]	95-ton fireless steam	H. K. Porter Co.
Republic Mining & Mfg. Co.	3	20-ton Diesel hydraulic	Whitcomb Loco. Co.
Sheffield Steel Corp.	2	50-ton Diesel-elec.	Whitcomb Loco. Co.
Southern Pacific	15[3]	1,000-hp. Diesel-elec.	American Loco. Co.
	5[3]	1,000-hp. Diesel-elec.	Baldwin Loco. Wks.
Stone & Webster Engrg. Co.	1	47-ton fireless	H. K. Porter Co.
United States Army	1	65-ton Diesel-elec.	General Electric Co.
	8	2-8-0	Lima Loco. Wks.
United States Government,[4] Tennessee Valley Authority	...	....	Whitcomb Loco. Co.
United States War Dept.	1	45-ton Diesel-elec.	Whitcomb Loco. Co.
	10	20-ton Gas-mech.	(Whitcomb Loco. Co.)
	5	20-ton Gas-mech.	Davenport-Besler Corp.
	5	20-ton Gas-mech.	Vulcan Iron Works
Washington & Old Dominion	3	44-ton Diesel-elec.	General Electric Co.
Westinghouse Elec. & Mfg. Co.	1	50-ton Diesel-elec.	Whitcomb Loco. Co.

Locomotive Inquiries

National Steel Co. of Brazil	6	0-6-0	
	2	0-8-0	
United States Navy Dept.	2	Diesel-elec.	
United States War Dept.[5]	100-200	2-8-2	

Freight-Car Orders

Road	No. of Cars	Type of Cars	Builder
Atchison, Topeka & Santa Fe	200	70-ton tank	Gen. Amer. Transp. Corp.
	75	70-ton hopper	(Gen. Amer. Transp. Corp.)
	200	Caboose	Company shops
Bethlehem Steel Co.	100	Gondola	Company shops
Canadian Pacific	50	70-ton hopper	Eastern Car Co.
Chicago, Indianapolis & Louisville	300	50-ton box	Pull.-Std. Car Mfg. Co.
Michigan Limestone & Chemical Co.	20	Dump	Austin-West. Road Mchy. Co.
Missouri Pacific[6]	1,450	50-ton box	American Car & Fdry. Co.
	50	50-ton hopper	(American Car & Fdry. Co.)
	50	70-ton coal	Mt. Vernon Car Mfg. Co.
	500	70-ton hopper	Pull.-Std. Car Mfg. Co.
	650	50-ton gondola	Pressed Steel Car Co.
	150	50-ton flat	Bethlehem Steel Co.
Reading	58	Caboose	Company shops
Southern	11	50-ton box	Pull.-Std. Car Mfg. Co.
Southern Pacific[7]	130	70-ton flat	Company shops
	10	70-ton dep. center flat	(Company shops)
	90	70-ton gondola	(Company shops)
	165	Cabooses	(Company shops)
United States Army	4[8]	Two-way dump	Austin-West. Road Mchy. Co.
United States Army, Engineering Dept.	3[9]	Tank	Gen.-Amer. Transp. Corp.
	..[10]	Dump	Pressed Steel Car Co.

Freight-Car Inquiries

Hicks, C. D. & Co.	300	Tank	
Carnegie-Illinois Steel Corp.	3	50-ton hopper	
National Rwys. of Mexico	150	40-ton stock	
	150	50-ton gondola	
	100	50-ton flat	
Tennessee Coal, Iron & R. R. Co.	10	70-ton air-dump	
Norfolk & Western	25	70-ton hopper	
Union Pacific	100	Cabooses	
United States Navy Dept.	10	40-ton box	
	12	40-ton flat	

Passenger-Car Orders

Road	No. of Cars	Type of Cars	Builder
Louisville & Nashville	3[11]	Coaches	Edw. G. Budd Mfg. Co.

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[1] Delivery received.

[2] Delivery received. Reported to be largest fireless steam locomotive ever built.

[3] Order unconfirmed.

[4] Cost, $70,200.

[5] Inquiry unconfirmed.

[6] Orders for the Missouri Pacific, Gulf Coast Lines, International-Great Northern and the Missouri-Illinois.

[7] For 1941 and 1942 delivery.

[8] At a cost of $12,193.

[9] Cost, $11,335.

[10] Cost, $43,825.

[11] The company expects to place two of these cars in service with the "Southwind" and one with the "Dixie Flagler," the Chicago-Florida coach trains operated over this railroad's lines between Louisville, Ky., and Montgomery, Ala., and between Evansville, Ind., and Nashville, Tenn., respectively.

Equipment Purchasing and Modernization Program

Chicago & North Western.—An improvement program costing approximately $450,000 is under way in the Chicago & North Western shops in the Chicago area. The principal feature of this project is the construction of a servicing yard for streamlined trains in the vicinity of the company's shops at Fortieth street and the transfer of the present servicing facilities for these trains to the new location. This necessitates the building of three inspection pits for the inspection of complete trains and power plants, suitable drop pits for changing wheels and a transfer table to permit changing of complete power trucks under the Diesel-electric locomotives. The pits have been designed so that duplicate servicing units may be added later as required. The estimated cost of this project alone is approximately $370,000. Other work in the program includes the construction of a mechanical drop pit table, an extension to the machine shop for repair work on locomotives and the construction of a locomotive blow-off tank at Proviso, Ill.

Denver & Rio Grande Western.—The D. & R. G. W. has asked the Interstate Commerce Commission for authority to assume liability for $1,260,000 of two per cent equipment trust certificates, maturing in 10 equal annual installments of $126,000 on November 1 in each of the years from 1942 to 1951, inclusive. The proceeds will be used as a part of the purchase price of new equipment costing a total of $1,692,460 and consisting of 500 50-ton, 40 ft. 6 in. box cars.

Missouri Pacific.—The Missouri Pacific has asked the Interstate Commerce Commission for authority to assume liability for $1,150,000 of equipment trust certificates, maturing in 10 equal annual installments of $115,000 on October 15 in each of the years from 1942 to 1951, inclusive. The proceeds will be used as a part of the purchase price of new equipment costing a total of $1,442,500 and consisting of two 4,000 hp. Diesel-electric passenger locomotives and 11 streamline, stainless-steel passenger cars. The passenger cars to be: One mail-storage car, two baggage-express cars, two baggage-mail cars, two deluxe coaches, two coach-grill crew cars, and two diner-lounge cars.

New York, Chicago & St. Louis.—The New York, Chicago & St. Louis has asked the Interstate Commerce Commission for authority to assume liability for $5,800,000 of serial equipment trust certificates, bearing interest at not more than three per cent and maturing in 10 equal annual installments of $580,000 on September 1 in each of the years from 1942 to 1951, inclusive. The proceeds will be used as part of the purchase price of new equipment costing a total of $6,589,128 and consisting of 15 class S-1, 2-8-4 freight locomotives; 250 all-steel, 50-ton hopper cars; 900 all-steel, 50-ton box cars; 250 50-ton gondola cars; and 100 all steel, 50-ton automobile cars. Orders for some of this equipment have been announced in recent issues.

New York, New Haven & Hartford.—The New Haven has awarded a contract

(Continued on second left-hand page)


GENERAL MOTORS
LOCOMOTIVES
2700 Hp. to 5400 Hp. Freight Locomotives
Rio Grande
5400
Everywhere West
9205
600 Hp. and 1000 Hp. Switchers
GREAT NORTHERN
5403
1000 Hp. Road-Switcher
2700 Hp. Transfer Locomotive

amounting to $31,300 to the Foskett & Bishop Company of New Haven, Conn., for the construction of facilities for fueling Diesel-electric locomotives at Dover street, Boston, Mass.

New York, Ontario & Western.—The N. Y. O. & W. has asked the I. C. C. to approve a plan whereby it would issue and sell to the Reconstruction Finance Corporation $162,900 of 2¾ per cent equipment trust certificates, maturing serially at the rate of $8,145 every six months until final payment on November 1, 1951. The proceeds will be used as a part of the purchase price of new equipment costing a total of $181,000 and consisting of five new Diesel-electric, 44-ton switching locomotives, the order for which was announced in the August issue.

Union Pacific.—The U. P. is completing the construction of a 140-ft. turntable at Green River, Wyo., for turning new 4-8-8-4 locomotives, 20 of which are being delivered by Alco.

Supply Trade Notes

HOWARD J. MULLIN, assistant to the sales manager for the Carnegie-Illinois Steel Corporation at Kansas City, Mo., has been appointed assistant to the manager of sales (Pittsburgh, Pa.), with headquarters at Detroit, Mich.

◆

FRANK M. BOSART, former district service representative at Buffalo, N. Y., for the Electro-Motive Corporation, has been transferred to the sales department and will be located at that company's offices at 230 Park Avenue, New York.

◆

GORDON LEFEBVRE, former executive of the American Locomotive Company, has been elected vice-president and general manager of the Cooper-Bessemer Corp.

◆

THE Packless Metal Products Corporation has moved its office and plant to new and larger quarters at 31 Winthrop avenue, New Rochelle, N. Y.

◆

CARNEGIE-ILLINOIS STEEL CORP. — *Paul F. Vander Lippe* has been appointed assistant to the manager of sales in charge of the Kansas City, Kan., office of the Carnegie-Illinois Steel Corporation to succeed *Howard J. Mullin,* who was recently transferred to Detroit, Mich.

◆

B. E. MIDDLETON, formerly Chicago representative for the McKenna Metals Company, has been appointed to represent the McKenna Company in the central New York territory. Mr. Middleton is located at 217 East avenue, Rochester, N. Y.

◆

JAMES A. FARQUHARSON has joined the staff of the O. C. Duryea Corporation as district representative, with headquarters in the Insurance Building, 907 Fifteenth street, N. W., Washington, D. C. Mr. Farquharson was formerly national legislative representative of the Brotherhood of Railroad Trainmen.

◆

COOLIDGE SHERMAN has been appointed Eastern sales manager of the Allegheny Ludlum Steel Corporation. Mr. Sherman has been associated with this company since 1916. From 1922 to 1930, he served as sales manager, Cleveland, Ohio district, for the Ludlum Steel Company, and from 1930 to 1938 as assistant to the president. Immediately previous to his latest appointment he was manager of valve steel sales.

W. T. CAPPS, formerly stoker supervisor of the Baltimore & Ohio, has been appointed sales engineer of The Standard Stoker Company, Inc. Mr. Capps began his business career as a special apprentice with the American Locomotive Company in 1909. In 1912, he was engaged by the Locomotive Stoker Company as draftsman and stoker engineer, which position he held until June, 1917, when he enlisted for service with the 19th Railway Engineers, United States Army. Upon his return from overseas service in July, 1919, he re-entered the employ of the Locomotive Stoker Company as a stoker engineer, in which capacity he remained until February, 1928. Shortly thereafter he was appointed stoker supervisor of the Baltimore & Ohio.


Underwood & Underwood
W. T. Capps

J. A. SAUER, executive vice-president of the Symington-Gould Corporation, has been elected a director of that company to succeed the late C. Loonis Allen.

◆

VAPOR CAR HEATING CO.—*L. A. Richardson,* formerly supervisor of air-conditioning equipment of the Chicago, Rock Island & Pacific, and *Vernon Coon,* formerly of the steam fitting and air-conditioning departments of the Chicago & North Western, have been appointed sales service engineers of the Vapor Car Heating Company, Inc., Chicago, with headquarters at Chicago and New York, respectively.

◆

NATIONAL BEARING METALS CORPORATION. — *William B. Given, Jr.,* has been elected president of the National Bearing Metals Corporation to succeed *J. B. Strauch.* Mr. Strauch was elected chairman of the board, which position was previously held by Mr. Given. Mr. Given is president of the American Brake Shoe & Foundry Co., which company owns a controlling interest in the National Bearing Metals Corporation.

◆

WESTINGHOUSE AIR BRAKE COMPANY.—*D. W. Lloyd* has been appointed Southwestern manager of the Westinghouse Air Brake Company, with headquarters at St. Louis, Mo., to succeed *E. W. Davis,* who retired in August, after 33 years of continuous service with the company. Mr. Lloyd entered the employ of the Westinghouse Air Brake Company in 1911 after graduating from Pennsylvania State College. He held, successively, at Wilmerding, Pa., the positions of special engineer, as-

* * *


Recently completed machine-tool assembly building of the Bullard Company at Bridgeport, Conn.
The building, one-story in height, is 540 ft. long by 180 ft. wide and is the largest of several additions built during the past year by the Bullard Company to meet expanding defense program demands.

sistant to the chief engineer, assistant engineer of tests, commercial engineer, assistant to the general manager and assistant to the vice-president. In 1928, he was appointed district engineer at St. Louis, Mo., and in 1940 became assistant Southwestern manager, which position he held until his recent appointment. Mr. Davis successively filled the positions of inspector, assistant district engineer, and representative. He was Southwestern manager for 14 years prior to his retirement.

Obituary

JOHN R. SEXTON, eastern sales manager of the Standard Stoker Company, Inc., New York, with headquarters at New York, died on September 22 at St. Luke's hospital, Chicago.

Personal Mention

General

J. J. NAPIER, superintendent of the Canadian National at Dauphin, Man., has retired. Mr. Napier was born in Cannington, Ont., on July 23, 1881, and entered railway service on the Grand Trunk (now part of the Canadian National system) in September, 1900. In 1903 he was appointed a locomotive fireman at Lindsay, Ont., and two years later he was transferred to the Canadian Northern (now part of the Canadian National) as a locomotive engineer on construction work between Sudbury, Ont., and Toronto. He remained on the Central region of the C. N. R. as a fireman, road foreman of engines, and assistant master mechanic until September, 1920, when he was promoted to superintendent, with headquarters at Hornepayne, Ont. Mr. Napier was transferred to Capreol, Ont., in 1926; to Brandon, Man., in 1927; to Melville, Sask., in 1930; to Brandon in 1931; to Winnipeg, Man., in 1933, and to Dauphin in April, 1941.

W. L. HOUGHTON, master mechanic at Chicago, has been appointed assistant superintendent of equipment of the New York Central at Chicago and superintendent of equipment of the Indiana Harbor Belt and the Chicago Junction Railway. Mr. Houghton was born at Toledo, Ohio, on October 28, 1891, and entered railway service on August 1, 1908, as an apprentice at the Beech Grove shops of the Cleveland, Cincinnati, Chicago & St. Louis (Big Four) at Indianapolis, Ind. He was later promoted successively to foreman, piece work inspector and assistant erecting foreman at Bucyrus, Ohio; general foreman at Stanley, Ohio, and assistant general foreman of the Linndale (Ohio) enginehouse. On August 1, 1939, Mr. Houghton became master mechanic at Chicago.

W. L. Houghton

JOHN E. BJORKHOLM, assistant superintendent of motive power on the Chicago, Milwaukee, St. Paul & Pacific, has been appointed superintendent of motive power, with headquarters as before at Milwaukee, Wis. Mr. Bjorkholm was born in Sweden on December 19, 1883, and took a correspondence school course. Before coming to this country he served as a deep sea diver, junior engineer in the submarine service of the Swedish Navy and fireman and junior engineer in the merchant marine. He entered railway service on October 1, 1906, as a fireman on the Milwaukee, later becoming engineer and traveling engineer, with headquarters at Milwaukee. On January 10, 1918, he was promoted to division master mechanic of the Chicago Terminal division, with headquarters at Chicago, and on April 1, 1919, Mr. Bjorkholm became assistant superintendent of motive power.

John E. Bjorkholm

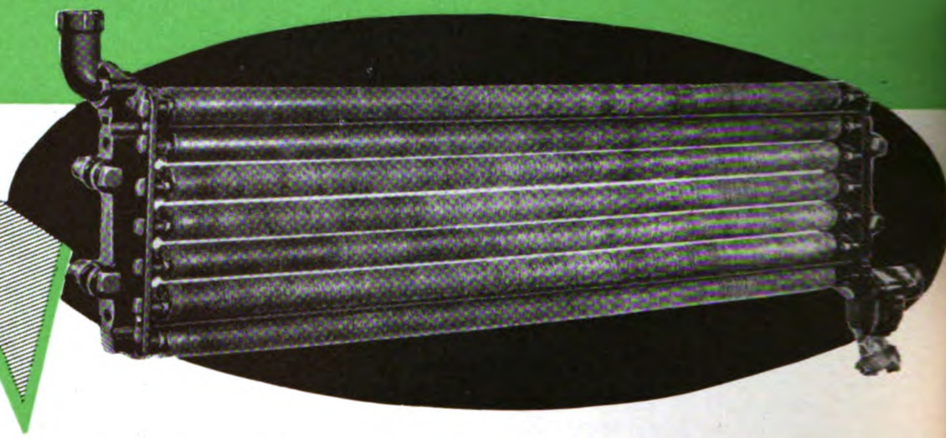
RALPH W. ANDERSON, superintendent of motive power of the Chicago, Milwaukee, St. Paul & Pacific, with headquarters at Milwaukee, Wis., who retired on September 1, was born in Madison county, Iowa, on May 5, 1877, and attended the Capital City Commercial college at Des Moines, Iowa. He entered railway service in 1892, as a machinist apprentice in the shop of the Des Moines Union Railway and in 1897 joined the Chicago, Rock Island & Pacific as a machinist, later serving as assistant enginehouse foreman and enginehouse foreman. In September, 1906, Mr. Anderson became connected with the Milwaukee as a machinist at Mitchell, S. D., and the following year he was promoted to assistant enginehouse foreman. In April, 1908, he was transferred to the Idaho division and two months later was promoted to mechanical foreman of that division. In May, 1909, Mr. Anderson was appointed enginehouse foreman at Avery, Idaho, and in November, 1911, he was transferred to Miles City, Mont. A year later he was promoted to district master mechanic, with the same headquarters, and in June, 1918, he became assistant superintendent of motive power of the Eastern lines, with headquarters at Milwaukee. Two years later Mr. Anderson was promoted to superintendent of motive power of the Eastern lines and in September, 1927, his jurisdiction was extended to cover the entire Milwaukee system.

Ralph W. Anderson

E. M. WILCOX, inventor of the car retarding system, assistant superintendent of equipment of the New York Central, Lines West of Buffalo, and the Michigan Central and superintendent of equipment of the Indiana Harbor Belt and the Chicago River & Indiana, with headquarters at Chicago, retired on September 1. Mr. Wilcox was born at Buffalo, N. Y., on August 13, 1871, and entered railway service in the mechanical department of the Lehigh Valley in 1892. In 1902 he joined the Lake Shore & Michigan Southern (now part of the New York Central) as assistant foreman at Collinwood, Ohio, and was later promoted successively to general foreman at Nottingham, Ohio, traveling foreman at Buffalo, N. Y., division general foreman, general car foreman at Gibson, Ind., and master car builder of the Indiana Harbor Belt and the Chicago Junction at Gibson. In May, 1932, Mr. Wilcox was appointed master car builder for the terminal district of the Michigan Central, and in February, 1933, his jurisdiction was extended to include the Western division of the New York Central, with headquarters at Chicago. In June, 1933, his jurisdiction was extended to include a portion of the Cleveland, Cincinnati, Chicago & St. Louis (Big Four) and in May, 1934, Mr. Wilcox was appointed superintendent of equipment, for the New York Central lines mentioned above, with

(*Continued on second left-hand page*)

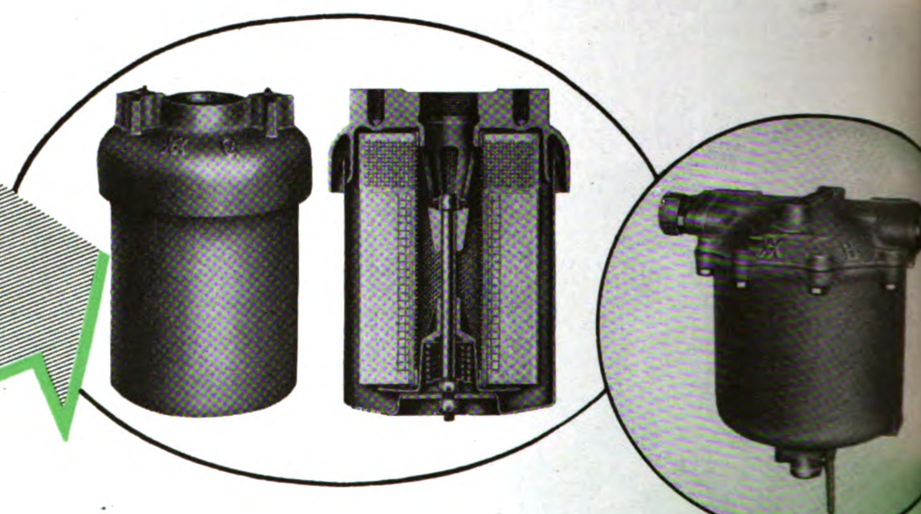
★ WAYS and MEANS to *Maintain the Integrity* of BRAKE PERFORMANCE



★ *Dry* AIR

AFTERCOOLER

The most effective means yet devised for removing moisture from the air supply is our compact radiator type Aftercooler, having automatic drain valve that ejects condensation each time the compressor governor operates. Thus, only dry air can reach the several brake devices, which helps immeasurably in maintaining functional reliability of the whole system.

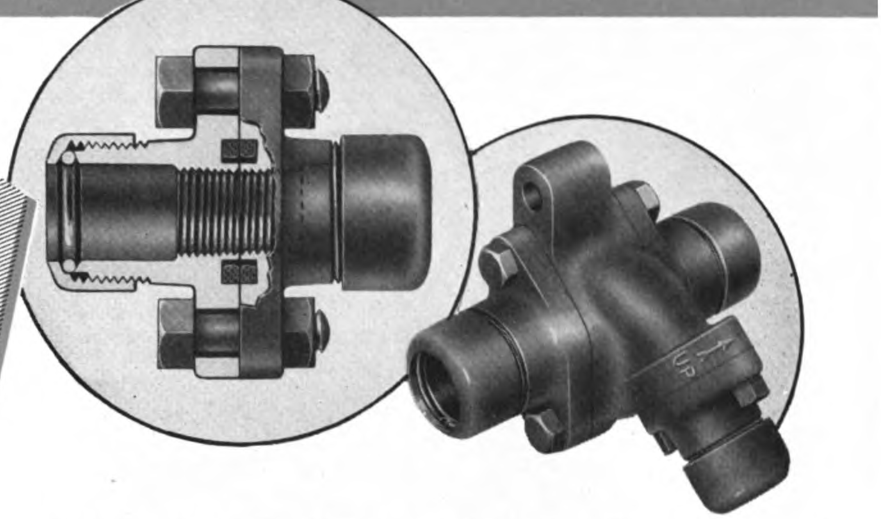


★ *Clean* AIR

Cartridge Type FILTERS

Remarkably efficient in providing clean air for brake devices, these Filters are used on the compressor inlet, main reservoir pipe, governor connections, and in the brake pipe passage of valves. (Brake cylinders are further protected by a felt seal and breather strainer at the non-pressure end). Particularly noteworthy have been the results with a filter on the compressor — unfailing service continuously between locomotive shoppings.

★ *Air-tight* **JOINTS**

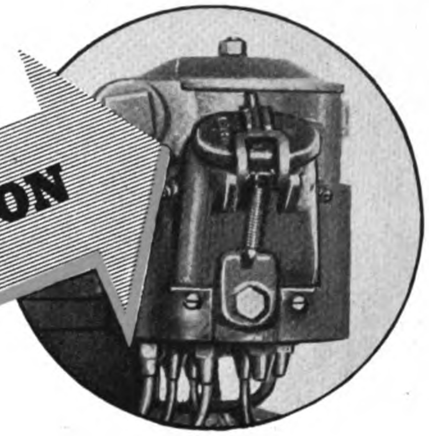


WABCOTITE Fittings

Leak-proof, non-breakable pipe joints on valve devices, main reservoirs, tees, elbows, and unions, are provided by Wabcotite Fittings. They save air, help definitely to perpetuate proper brake functioning, and require no maintenance.

★ *Proper* **LUBRICATION**

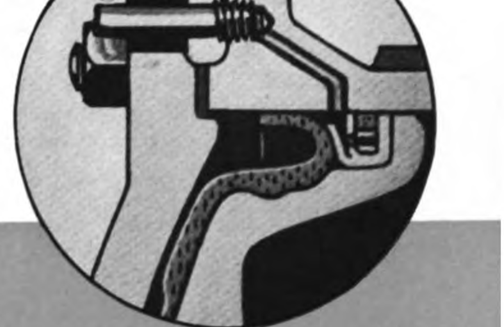
for COMPRESSORS



Our mechanical Lubricator injects minute quantities of oil to the air compressor, positively and regularly. Moving parts are thus kept in working order, passages open, rings free, valves tight, and wear at a minimum. This condition materially lengthens the uninterrupted service life of a compressor and drastically cuts the cost of upkeep.

for CYLINDERS

In the cylinder piston is a groove packed with lubricant that holds its body and does not disintegrate. A saturated felt swab distributes grease over the cylinder wall with each piston movement. This method of lubrication keeps the cylinder in good condition and helps to extend maintenance-free life of the equipment.



WESTINGHOUSE... AIR BRAKE COMPANY *Wilmerding, Pa.*

★ All devices illustrated — fundamental parts of modern equipments — have proved invaluable in preserving the integrity of brake performance, and reducing maintenance costs, which contribute to transportation efficiency. We strongly recommend that they be made available for equipments already in service by suitable conversion. Such procedure will be a sure paying investment.

headquarters at Chicago. On November 1, 1937, the position of superintendent of equipment on the New York Central, Michigan Central and Big Four at Chicago was abolished, and he was appointed assistant superintendent of equipment, with

E. M. Wilcox

the same headquarters. Mr. Wilcox has been active in the Car Department Officers Association for many years, serving as a director from 1937 to 1940. He also served as second vice-president of the Western Railway Club during the year 1936-1937. He is the inventor of the car retarder system, now extensively used on hump yards throughout the country. For his work in this development Mr. Wilcox received the Henderson Gold Medal of the Franklin Institute, Philadelphia, Pa., in 1930.

PAUL MULLEN, master mechanic of the Chicago, Milwaukee, St. Paul & Pacific at Savanna, Ill., has become assistant superintendent of motive power, with headquarters at Milwaukee, Wis.

Master Mechanics and Road Foremen

G. P. ROFFE, general foreman of the enginehouse on the New York Central at Linndale, Ohio, has been appointed master mechanic at Chicago.

ROBERT FLOCKHART has been appointed a road foreman of engines on the Denver & Rio Grande Western with headquarters at Grand Junction, Colo.

H. C. WRIGHT, master mechanic of the Williamsport division of the Pennsylvania, with headquarters at Renovo, Pa., has been transferred to the Middle division.

J. F. KELKER, gang foreman of the Pennsylvania at Conway, Pa., has become assistant enginehouse foreman with the same headquarters.

W. C. FLECK, assistant enginehouse foreman of the New York division of the Pennsylvania, has been appointed enginehouse foreman of the Williamsport, Pa., division.

T. L. PREUN, master mechanic of the Pennsylvania at Buffalo, N. Y., has been transferred to the Williamsport division, with headquarters at Renovo, Pa.

J. F. HUNT, assistant master mechanic of the Pennsylvania, Philadelphia division, has been appointed master mechanic, with headquarters at Buffalo, N. Y.

C. F. MACKALL, assistant road foreman of engines of the Pittsburgh, Pa., division of the Pennsylvania, has been appointed road foreman of engines, Monongahela division.

W. W. HENDERSON has been appointed master mechanic of the Hastings and Dakota division of the Chicago, Milwaukee, St. Paul & Pacific, with headquarters at Aberdeen, S. D.

J. L. BOSSARD, master mechanic of the Hastings and Dakota division of the Chicago, Milwaukee, St. Paul & Pacific at Aberdeen, S. D., has been transferred to Savanna, Ill.

H. D. AHN, assistant engineer motive power in the office of the chief of motive power of the Pennsylvania, has been appointed assistant master mechanic of the Philadelphia division.

EARL FISHER, general foreman on the Denver & Salt Lake at Phippsburg, Colo., has been appointed acting master mechanic, with headquarters at Utah Junction, Colo.

LAUREL BOYNE JOHNSON, general foreman of the locomotive department of the Atchison, Topeka & Santa Fe at Clovis, N. M., who has been appointed master mechanic of the Panhandle & Santa Fe at Slaton, Tex., as announced in the September issue, was born at Whittemore, Iowa, on October 15, 1892. Mr. Johnson entered railway service with the Panhandle & Santa

L. B. Johnson

Fe at Clovis, on May 18, 1910, as an apprentice. He became a machinist on April 10, 1914, and later received a special assignment at the Baldwin Locomotive Works. He became gang foreman at Winslow, Ariz., on September 21, 1914, erecting shop foreman at Clovis on June 22, 1922, and general foreman on May 22, 1941.

E. M. TAPP, assistant master mechanic of the Union Pacific at Salt Lake City, Utah, has been appointed master mechanic of the newly created Utah division, with headquarters at Salt Lake City.

L. E. MCCORKLE, assistant enginehouse foreman on the Norfolk & Western at Bluefield, W. Va., has been appointed assistant master mechanic on the Scioto division with headquarters at Portsmouth, Ohio.

Car Department

FRANK ALT, general car foreman on the Union Pacific at Cheyenne, Wyo., has been promoted to general car inspector, with the same headquarters.

Shop and Enginehouse

G. W. MEREDITH, machinist at the Pulaski, Va., shop of the Norfolk & Western has been appointed night enginehouse foreman with the same headquarters.

HARRY E. TROUP, gang foreman of the Canton, Ohio, enginehouse of the Pennsylvania, has been appointed assistant enginehouse foreman with the same headquarters.

E. E. HINCHMAN, master mechanic on the Southern Pacific at Bakersfield, Calif., has been appointed superintendent of the Los Angeles general shops, with headquarters at Los Angeles, Calif., succeeding G. B. Hart, who has been granted a leave of absence.

Purchasing and Stores

R. I. RENFREW, district storekeeper of the New York Central at Beech Grove, Ind., has been appointed assistant general storekeeper, with headquarters at Beech Grove.

C. L. CLAPP, signal storekeeper of the Leota street shops of the New York Central at Indianapolis, Ind., has been transferred to the position of district storekeeper at Beech Grove, Ind.

W. J. SIDEY, acting general storekeeper of the Lehigh Valley at Sayre, Pa., has been appointed general storekeeper. Mr. Sidey entered railway service immediately after leaving school and served part-time apprenticeships in the car and locomotive shops, drawing room, track section, car service department and accounting department of the Buffalo, Rochester & Pittsburgh (now Baltimore & Ohio) at Du Bois, Pa. He then worked for several wholesale concerns in Rochester, N. Y., in their shipping, billing, and stock departments. He later returned to the Buffalo, Rochester & Pittsburgh in its material supply service. He then worked for six years as storekeeper in charge of material stocks with the General Electric Company in one of its subsidiary plants at Wellsville, N. Y. Mr. Sidey returned to the railroad field in 1922 as division storekeeper of the Lehigh Valley, Jersey City, N. J., serving successively as traveling storekeeper at Wilkes-Barre, Pa.; division storekeeper at Coxton, Pa.; and supervisor of scrap and reclamation at Sayre. He was appointed acting general storekeeper on February 1, 1941, and became general storekeeper in June, 1941. Mr. Sidey has served on committees of the Purchases and Stores division of the Association of American Railroads for the past 12 years, both as a member and as chairman.

Railway Mechanical Engineer

November 1941

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Locomotives:

General:

Cars:

Editorials:

Readers' Page

Car Foremen and Inspectors:

Backshop and Enginehouse

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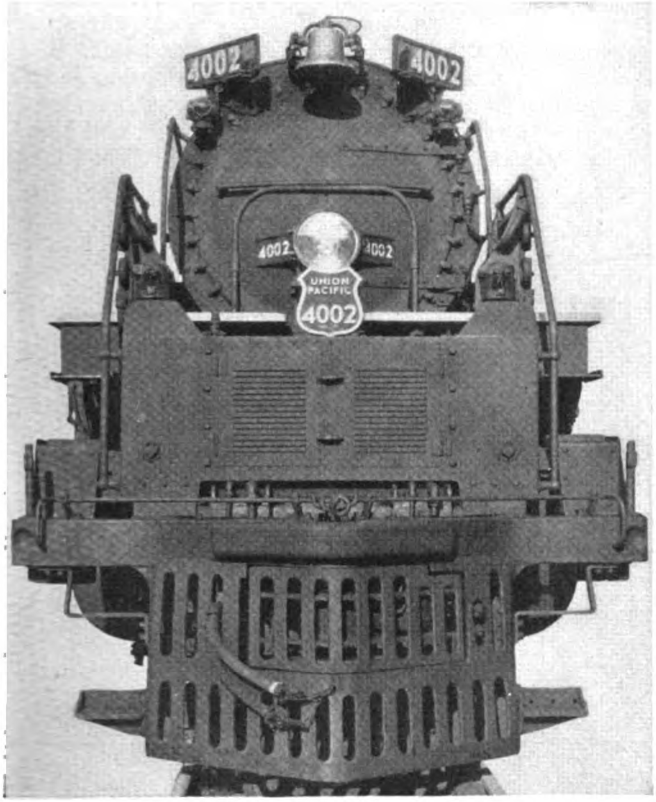
RAILWAY MECHANICAL ENGINEER

Union Pacific Buys

Twenty 4-8-8-4 Locomotives



With the coupler retracted, the pilot surface is smooth and unobstructed

Heaviest single-expansion articulated locomotives to handle maximum tonnage without helpers on 1.14 per cent mountain grades—Running gear distinguished by high degree of controlled flexibility

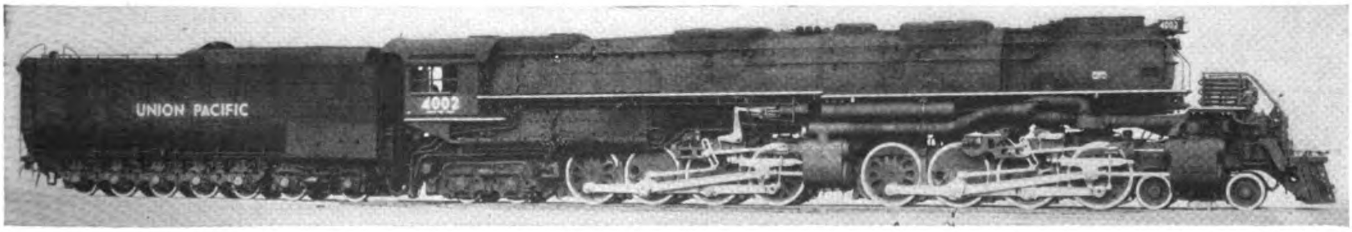
TWENTY 4-8-8-4 type articulated locomotives, the largest in size and heaviest in point of total engine and tender weight of any single-expansion locomotives of this wheel arrangement, are being delivered to the Union Pacific by the American Locomotive Company. The length over couplers is 132 ft. 9⅞ in.; the weight of engine and tender, 1,197,800 lb., and tractive force, 135,375 lb. The locomotives are also notable for many refinements affecting their performance.

The basic design was developed by engineers of the Research and Mechanical Standards Department of the Union Pacific, under the direction of Otto Jabelmann, vice-president, to originate a locomotive capable of hauling maximum tonnage and maintaining schedules without helper service over the Wahsatch Mountains on a ruling grade of 1.14 per cent between Ogden, Utah, and Green River, Wyo. Results of exhaustive road tests and experience gained in operation of other single-expansion articulated locomotives were furnished to the American Locomotive Company which collaborated with the Union Pacific engineers in designing the locomotive.

The new locomotives can operate on any part of the railroad and were designed for speeds up to 80 m. p. h. and to produce maximum power output continuously at 70 m. p. h.

The design of running gear permits great flexibility when moving around curves and at the same time provides for relatively high rigidity when operating on tangent track. The spring-rigging suspension of the locomotive also permits adjustment of the wheels to vertical curves with relatively little distortion of the weight distribution.

The arrangement of the running gear for tracking on curves embodies what is designated by the builder as the "lever principle." This term is applied to a system of lateral-motion control and spring-rigging suspension, the function of which is to fit all wheels of the locomotives to the rails on curves with maximum freedom from binding and to adjust the wheels to vertical curves encountered with changes of grade with a minimum of disturbance to the distribution of the locomotive weight.

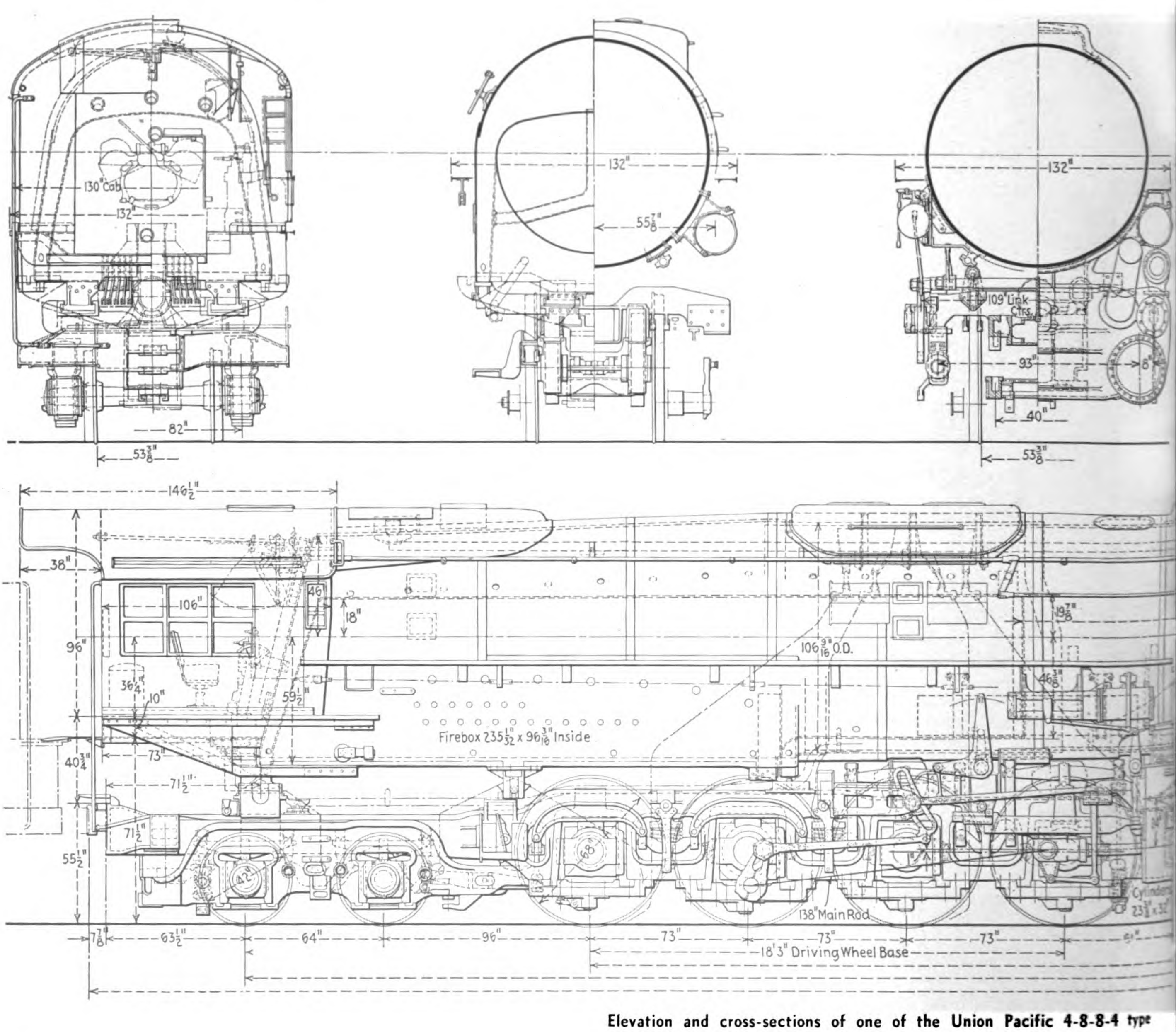


The use of the term "lever principle" arises from the employment of a definitely selected pivot point in the locomotive wheel base about which the mass of the locomotive rotates with respect to the track as the locomotive passes around curves. On an eight-coupled driving-wheel base this is the rear pair of driving wheels in which no provision is made for lateral movement of the axle with respect to the locomotive bed. The guiding wheels on the front engine unit (the front pair of truck wheels and the front pair of driving wheels) have provision for ample lateral movement against controlled resistance. The initial resistance of these wheels is about 17 per cent, increasing gradually as the movement progresses. The second and third pairs of driving wheels adjust themselves freely against a somewhat lower initial resistance and through a somewhat less range of lateral movement than that effective on the guiding wheels. Wheels back of the pivot pair control the movement of the rear end of the locomotive against an initial lateral resistance somewhat lower than that of the guiding wheels. All wheels are fitted to track gage with a setting of 53⅜ in. between the backs of the tires.

The effect of this arrangement is to produce a rigidly guided locomotive when on tangent track which adjusts itself freely on curves with a guiding force cushioned in its application. Locomotives on which this arrangement has been used are said to move around curves smoothly with complete absence of the succession of violent guiding oscillations characteristic of many existing steam locomotives.

In counterbalancing advantage has been taken of the absence of the tendency to nose, brought about by the lateral rigidity of the wheel base on tangent track, to keep down the overbalance. This has been fixed conservatively at 28 per cent of the reciprocating weights.

In order to relieve the tendency of locomotives with long wheel bases to overload the driving springs when passing over convex vertical curves at summits and to under load them with corresponding overloading of the truck springs at the ends of the wheel base when passing over a concave curve an unusual degree of flexibility has been provided in the spring rigging by the employment of coil springs at all points of anchorage of the spring rigging to the engine bed and to the trailer truck. Each of these cushion springs comprises two 8-in. double coils in tandem; they permit the elongation or shortening of what are customarily hangers of fixed length, and permit vertical adjustments throughout the entire wheel base to



Elevation and cross-sections of one of the Union Pacific 4-8-8-4 type

conform to the track with a minimum of distortion of the adhesion weight on the driving wheels. With this arrangement the main springs of the system are designed with an overload factor of only 5 per cent.

Unusual attention has been given to insuring freedom of adjustment of the entire spring-rigging suspension system. Wherever possible, the spring hangers are of the loop type. Alemite lubrication is applied to the circular curved surfaces between the hanger loop and the spring gib. Cross-equalizer hangers have ball ends which hang in removable seats in oil-waste-packed pockets in the equalizer.

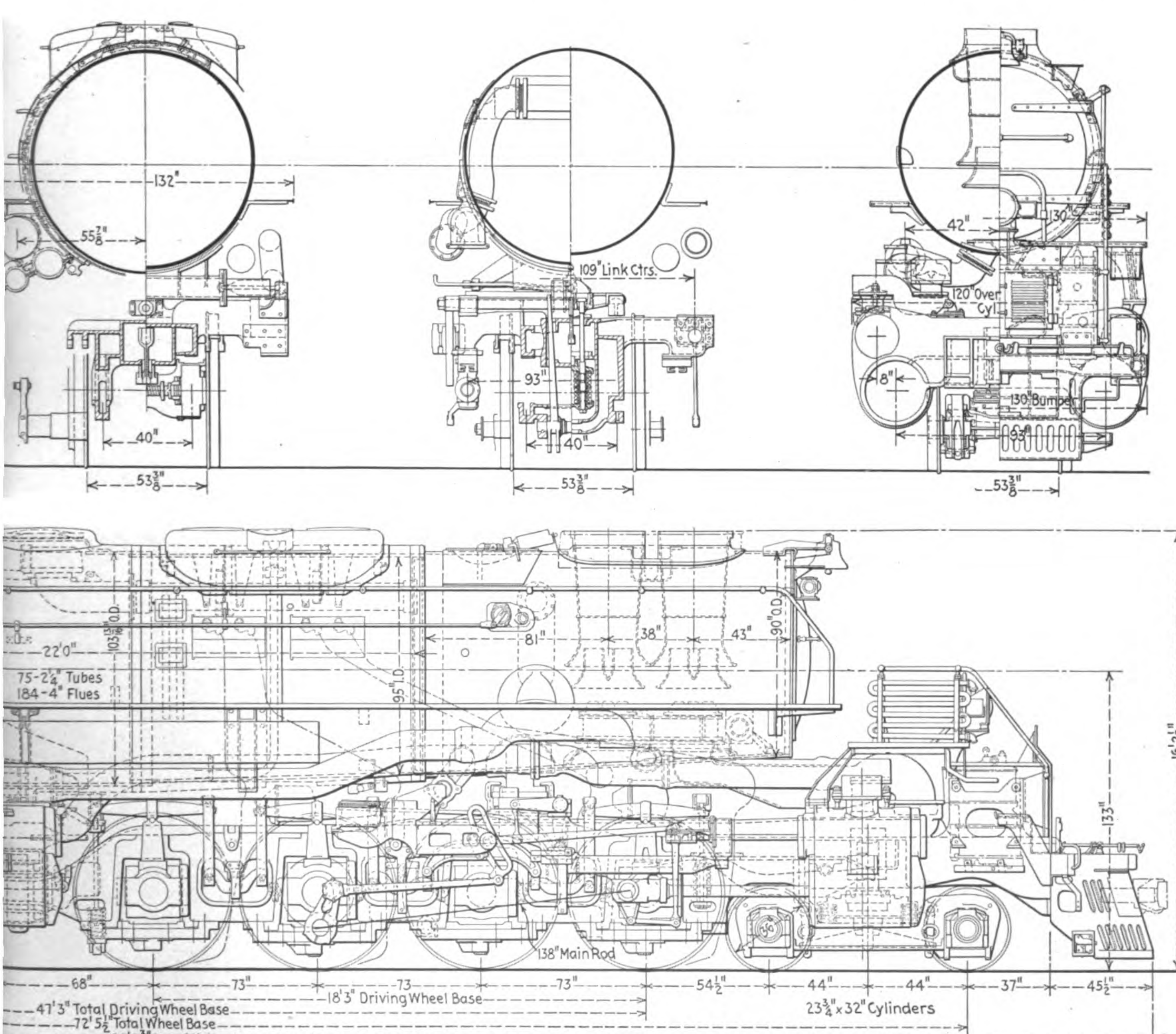
The locomotive as a whole has a three-point suspension. All driving wheels of the front engine are equalized on each side and the two sides are cross-equalized at the front end to the suspension of the rear end of the main equalizer beam, the front end of which bears in the Bissel type center pin of the engine truck. Each side of the rear engine is equalized as a unit from front to back, including both trailer wheels.

Foundation and Running Gear

The two engine beds of the locomotive are connected by a vertical articulation hinge with the pocket and pin at the front end of the rear engine bed and the tongue at the rear end of the front engine bed, which is similar to the arrangement developed by the Union Pacific for their 4-6-6-4 type single-expansion locomotive. The two engine units are so arranged that when the boiler load is applied to the waist-sheet support on the front engine bed a load of about seven tons is delivered to the top of the tongue from the rear engine bed. The two engine units are thus completely rigid in a vertical plane and all adjustments to vertical curvature is through the spring-rigging suspension.

A combination of coil and elliptic springs characterize the Alco four-wheel engine truck. These operate in parallel. The inclined-plane-and-geared-roller centering device has an initial resistance to lateral movement of 18 per cent, increasing to 33 per cent. The center plate is sealed to exclude dust and is force-feed lubricated. Oil is also fed to the racks and roller teeth of the centering device. The wheels are 36 in. in diameter and have SKF inside journal bearings which are tied together with a one-piece top-half integral box, making this a non-self-aligning bearing.

The General Steel Castings four wheel-trailing truck has 42-in. wheels with SKF twin-bearing outside journal

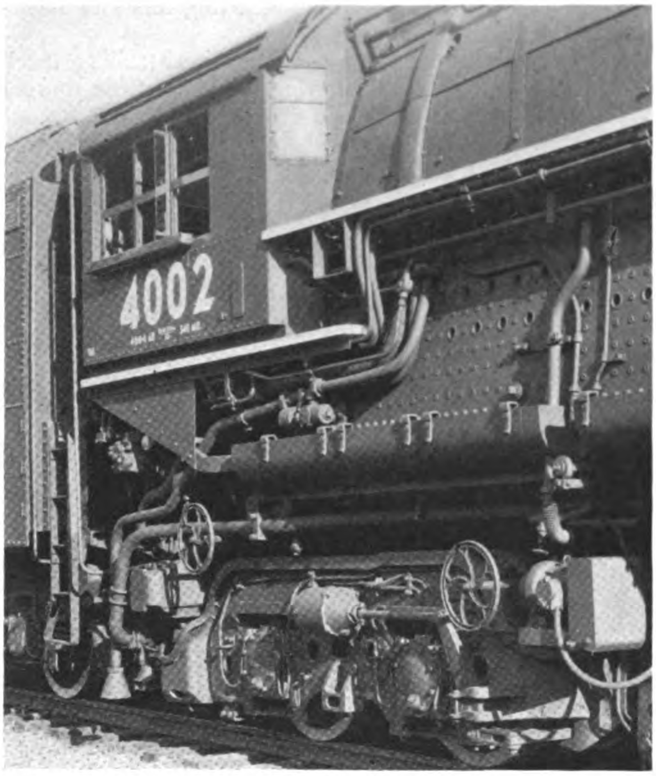


single-expansion articulated locomotives for fast freight service

boxes. It has a centering device with a 10 per cent initial resistance, increasing to 15 per cent and thence remaining constant.

The driving wheels, which are 68 in. in diameter over the tires, are of the Boxpok type. The axle journals have Timken roller bearings. The driving boxes and all other roller-bearing boxes on the locomotive are fitted with heat indicators. Driving boxes are equipped with Franklin compensator and snubber wedge assemblies. Alco lateral-motion devices are applied on the three leading driving axles of each engine unit.

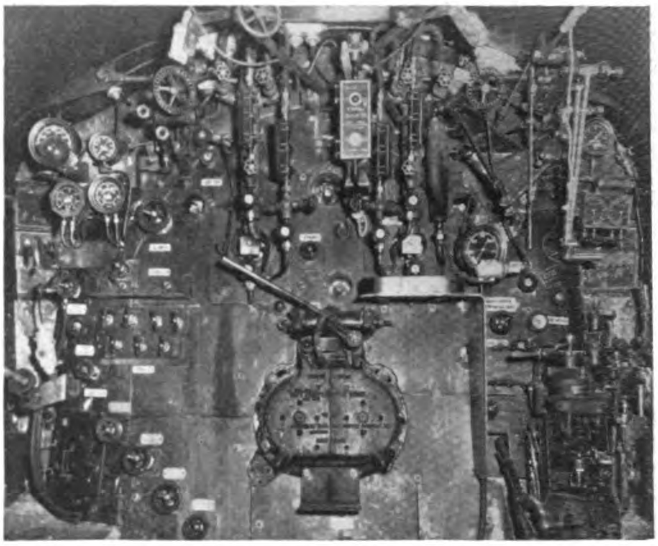
The side rods are of the articulated type, eliminating knuckle-pin connections, similar to those developed by the Union Pacific for their first order of 4-8-4 type freight and passenger locomotives. Vertical grease pockets are located in the bodies of the rods adjoining the crankpins, except for the ends of the rods on the intermediate crank pin. This bearing is lubricated from the hollow bore of the crank pin. The driving axles,



Alongside the firebox

the main and side rods, crank pins and piston rods are heat-treated low-carbon-nickel steel.

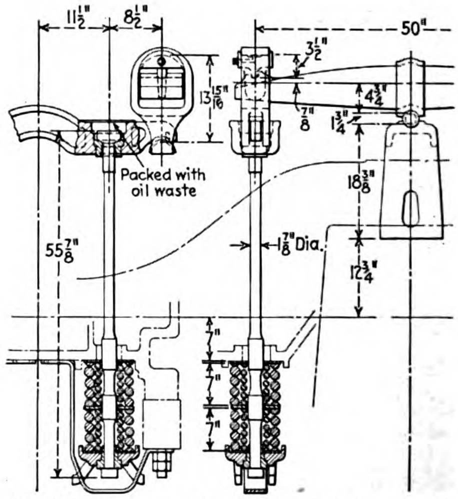
The pistons were furnished by the Locomotive Finished Material Company. They are of light alloy-steel rolled section with three T-section combination bronze and cast-iron piston packing rings. The crossheads are manganese-Vanadium alloy-steel castings and operate in multi-bearing guides. The guides are carbon-steel forg-



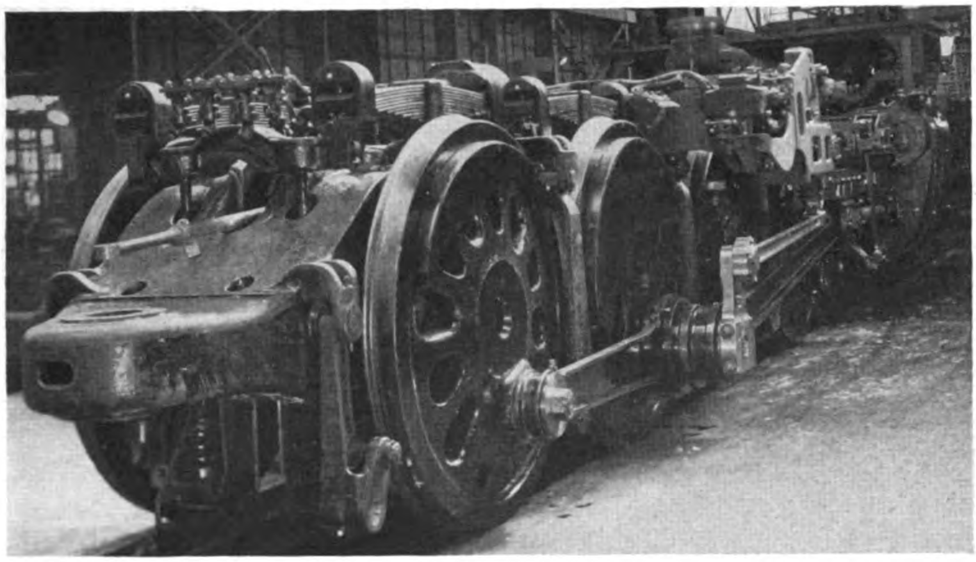
The back head presents an orderly arrangement of valves, gauges, and controls

Principal Dimensions, Weights and Proportions of the Union Pacific 4-8-8-4 Type Locomotive

Railroad	Union Pacific
Builder	Amer. Loco. Co.
Type of locomotive	4-8-8-4
Road numbers	4000-4019
Date built	1941
Service	Fast frt.
Dimensions:	
Height to top of stack, ft.-in.	16-2½
Height to center of boiler, ft.-in.	11-1
Width overall, in.	132
Cylinder centers, in.	93
Weights in working order, lb.:	
On drivers	540,000
On front truck	97,000
On trailing truck	125,000
Total engine	762,000
Tender	435,800
Wheel bases, ft.-in.:	
Driving, total	47-3
Front engine	18-3
Rear engine	18-3
Engine, total	72-5½
Engine and tender, total	117-7
Wheels, diameter outside tires, in.:	
Driving	68
Front truck	36
Trailing truck	42
Engine:	
Cylinders, number, diameter and stroke, in.	4-23¾x32
Valve gear, type	Walschaert
Valves, piston type, size, in.	12
Maximum travel, in.	7
Steam lap, in.	1⅜
Exhaust clearance, in.	⅛
Lead, in.	¼
Cutoff, max., in full gear, per cent	81
Boiler:	
Type	Straight top
Steam pressure, lb. per sq. in.	300
Diameter, first ring, inside, in.	95
Diameter, largest, outside, in.	106 9/16
Firebox length, in.	235 1/32
Firebox width, in.	96 3/16
Height mud ring to crownsheet, back, in.	77½
Height mud ring to crown sheet, front, in.	79⅜
Combustion chamber length, in.	112
Security circulators, number	7
Tubes, number and diameter, in.	75-2¼
Flues, number and diameter, in.	184-4
Length over tube sheets, ft.-in.	22-0
Net gas area through tubes and flues, sq. ft.	11.33
Fuel	Soft coal
Grate area, sq. ft.	150.3

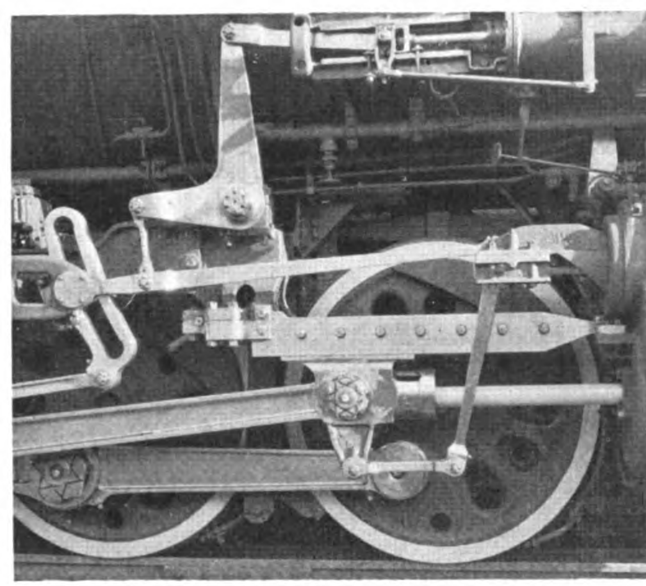


Details of the spring-rigging attachment to the engine bed at the rear end of the front engine unit

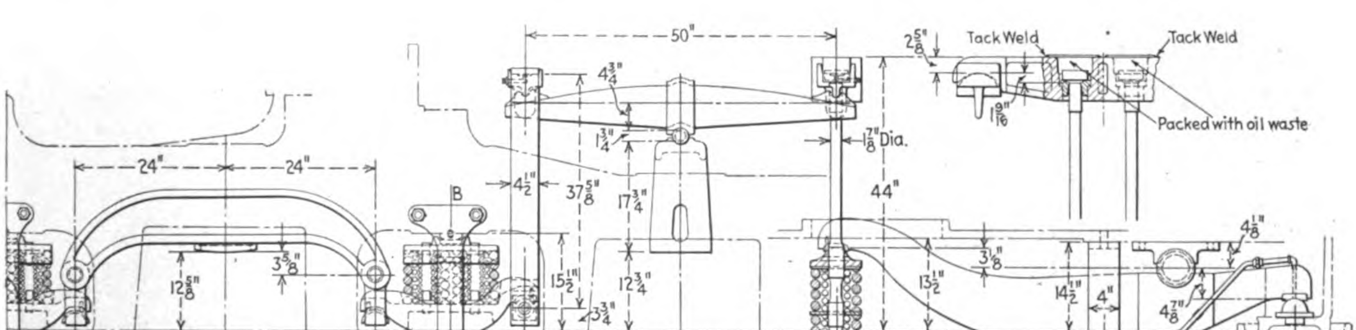


The rear end of the front engine unit

Heating surfaces, sq. ft.:	
Firebox and comb. chamber	593
Security circulators	111
Firebox, total	704
Tubes and flues	5,185
Evaporative, total	5,889
Superheater	2,466
Comb. evap. and superheater	8,355
Tender:	
Type	Water bottom
Water capacity, gal.	25,000
Fuel capacity, tons	28
Trucks (one)	Four-wheel
Rated tractive force, engine, lb.	135,375
Weight proportions:	
Weight on drivers ÷ weight engine, per cent	70.87
Weight on drivers ÷ tractive force	4.00
Weight of engine ÷ evaporative heating surface	129.4
Weight of engine ÷ comb. heating surface	91.2
Boiler proportions:	
Firebox heating surface, per cent comb. heating surface	8.43
Tube-flue heating surface, per cent combined heating surface	62.06
Superheater heating surface, per cent combined heating surface	29.52
Firebox heating surface ÷ grate area	4.69
Tube-flue heating surface ÷ grate area	34.50
Superheater heating surface ÷ grate area	16.40
Comb. heating surface ÷ grate area	55.59
Gas area, tubes-flues ÷ grate area	0.0754
Evaporative heating surface ÷ grate area	39.18
Tractive force ÷ grate area	900.6
Tractive force ÷ evaporative heating surface	23.0
Tractive force ÷ comb. heating surface	16.2
Tractive force × diameter drivers ÷ comb. heating surface	1,101.5



Running-gear details of a rear engine unit



Part of the spring rigging of the front engine unit showing the cross equalization at the rear of the engine-truck equal beam and the use of coil equalizer springs where clearance does not permit the use of semi-elliptic springs

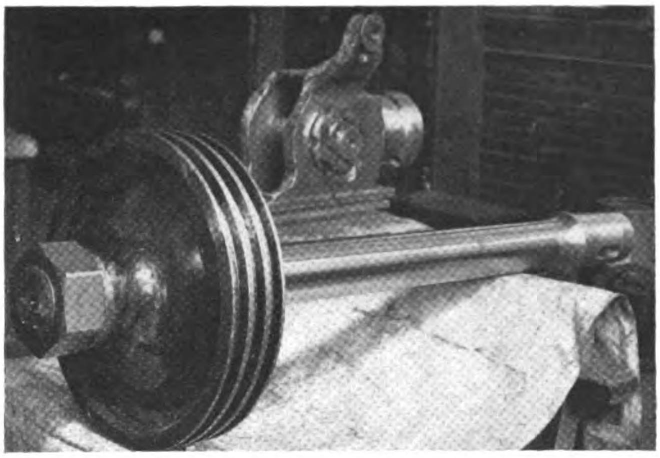
The front and rear engine-bed castings

ings, secured at both ends by heavy clamps so that in adjusting themselves to the lateral expansion of the cylinders the bolts are not subjected to shearing stresses.

The weight of reciprocating parts on each side of the locomotive is 2,106 lb. on the front engine and 1,912 lb. on the rear engine. The weight of the main rod is apportioned between reciprocating and revolving weights by the center-of-percussion method. All revolving weights are balanced in each wheel and overbalance for 28 per cent of the reciprocating weights is divided equally among all wheels. The main driving wheels are cross-balanced. To avoid the use of separate patterns, the primary counterbalance is symmetrical about the diameter through the crank pin and in the wheel center are cast separate secondary counterbalance pockets at either end of the primary counterbalance for the cross-balance correction. One of these is used and closed with a steel plate, welded on. The other is left open. The maximum dynamic augment at diametral speed is 7,590 lb.

Steam Pipes and Steam Distribution

The live- and exhaust-steam pipes applied to these locomotives are larger than those heretofore applied to



The piston and crosshead

any other single-expansion articulated locomotives. Test data developed by the Research and Mechanical Standards Department of the Union Pacific conclusively demonstrated that, to utilize full boiler capacity and develop maximum power output, past practices could not be followed. The arrangement of the steam pipes applied to these locomotives represents a further development of the system of flexible connections to the leading pair of cylinders which has been employed on a number of articulated locomotives previously turned out by this builder. By this system steam from the branch pipes is divided and delivered directly to each pair of cylinders. By the use of a short rotating steam-pipe connection at the cylinder, to the outer end of which the longer flexible connection to the branch-pipe is attached by a flexible joint, these pipes adjust themselves to the lateral movement of the front engine on curves without the use of slip joints. The three flexible connections in each pipe are full ball joints, permitting complete freedom of adjustment. While the use of ball joints at these locations is not new, those installed on the Union Pacific locomotives have been materially simplified in design.

Because of the universal movement permitted by the ball joints, a pair of outrigger studs has been applied to the ball-joint casing at each cylinder. There is normally a small clearance between the ends of the studs and the face plate over which they move as the joint rotates. Should this joint and the pipe arm attached tend to roll out of alignment when there is no pressure in the pipes these studs prevent the pipe from tipping out of alignment.

The main steam pipes to both pairs of cylinders are insulated with Unarco Insubestos pipe covering.

The expansion joint at the rear end of the long steam pipe to the rear cylinders is balanced against the effect of internal pressure.

The cylinders, together with the back cylinder heads, are integral parts of the bed castings. Both cylinders and valve chambers have Hunt-Spiller gun-iron bushings.

The steam distribution is effected by 12-in. piston valves and is controlled by Walschaert valve gear. The valves are Hunt-Spiller lightweight design with Duplex bronze and cast-iron lip-type packing rings.

All pins in the Walschaert valve gear, except the eccentric crank pin are fitted with McGill needle bearings. An SKF self-aligning roller bearing is applied on the eccentric crank pin. The union links, combination lever, radius bars, radius-bar lifters, and valve stems are heat-treated low-carbon nickel steel. The links, link blocks, and valve-motion pins are casehardened.

The reverse gear is an Alco special Type H with a 12-in. by 24-in. cylinder. Compensating springs are applied to the reverse shafts on both engines.

Lubrication

Mechanical application of oil lubrication to these locomotives is effected by four Nathan DV7 36-pint mechanical lubricators with a total of 49 feeds leading through Detroit two- and four-way dividers and terminal checks to 123 oil outlets, exclusive of the air compressors and tender. The points lubricated include the valves, cylinders, cylinder cocks, piston-rod packing, steam-pipe and exhaust-pipe ball and slip joints, the driving boxes and driving-box wedges, guides, engine-truck and trailer-truck center plates, trailer-truck journal boxes, engine-truck lateral-motion device, throttle, reverse gear, articulation hinge pin, stoker, and radial buffer. Two of these lubricators supply cylinder oil to the bearings subjected to steam temperature; the other two furnish lubrication for the chassis bearings.

In addition to the oil lubrication, all spring-rigging joints, brake-rigging pins, and valve-motion bearings have Alemite fittings. In the few points at which pin

connections are used in the spring rigging, the pins fit in Grafitex self-lubricating bushings.

The Boiler

The boiler has three barrel courses and, due to thickness, the sheets were cold rolled and then stress relieved before riveting the seams. The first course is conical with an inside diameter of 95 in. at the front end. The third course, which surrounds the combustion chamber, is $106\frac{9}{16}$ in. outside diameter. All longitudinal seams are of the saw-tooth type riveted and caulked inside and outside; also, all circumferential seams are caulked inside and outside. The firebox is $235\frac{1}{32}$ in. in length by $96\frac{3}{16}$ in. in width, and the combustion chamber is 112 in. long. The crown sheet is about *27* ft. in length and has a relatively small slope; the highest point at the front tube sheet is only $1\frac{7}{8}$ in. higher than the lowest point at the door sheet.

Practically the entire-boiler structure is built of Bethloc steel. This includes the barrel sheets and the firebox wrapper sheets, as well as the entire inside firebox. The front barrel sheet is $1\frac{11}{32}$ in. thick, and the two larger courses $1\frac{3}{8}$ in. each. The smokebox is of three-piece welded construction, to which is attached the boiler bearing, thus relieving the boiler barrel of any shock load which may be transmitted from the front engine unit.

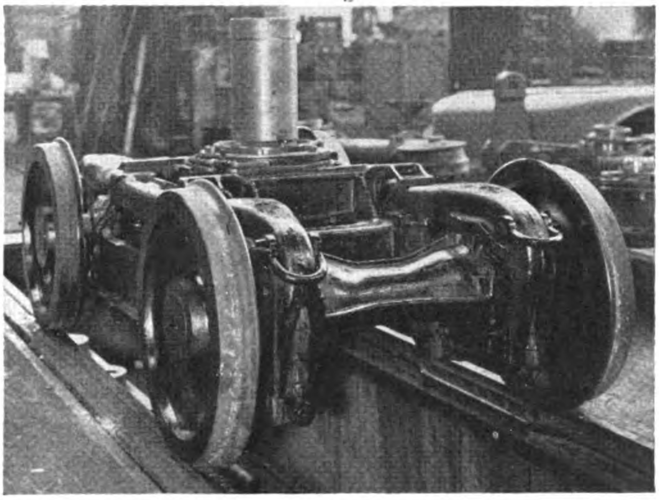
All seams in the firebox, including the attachment of the back tube sheet to the combustion chamber, are welded. At the mud ring the caulking edges of the inside sheets are welded around all four corners, and the outside sheets around the front corners. At the back, the caulking edge of the outside sheet is welded around the corners and entirely across the mud ring. Seal welding is also applied to the outside caulking edges of the wrapper-sheet and back-head seams, to the side- and roof-sheet seams, and to a large part of the front wrapper-sheet seams. The ends of the longitudinal barrel seams are also seal welded.

The Flannery flexible staybolts have the MK type caps. There is a complete installation of flexibles around the combustion chamber and over the crown sheet. There are flexible bolts also along the top of the side sheets, across the top rear corner of the side sheets, and around the rear corners of the firebox. Flexible bolts are also applied at all locations on the back head under the cab deck. The rear firebox corners have radii of 24 in. inside and 25 in. outside at the mud ring, tapering upward to the customary short radii near the top of the side wrapper sheet.

The firebox is supported on the engine bed by four sliding-shoe furnace bearers. Each is enclosed by an oil-tight sheet-steel casing and is immersed in an oil bath.

In the firebox are seven Security circulators and through each side are 20 secondary air tubes.

The boilers have the Electro-Chemical Engineering Company foam-collapsing trough and automatic blow-down system. The Wilson blow-off cocks in the firebox side near the back head are pneumatically operated and are piped into the centrifugal separator which forms a part of the automatic blow-down system. An additional blow-off cock is provided in the belly of the boiler at the front end of the first course, with the nozzle directed toward the firebox for use in blowing down and filling the boiler. Blow-off cocks which are hand-operated from

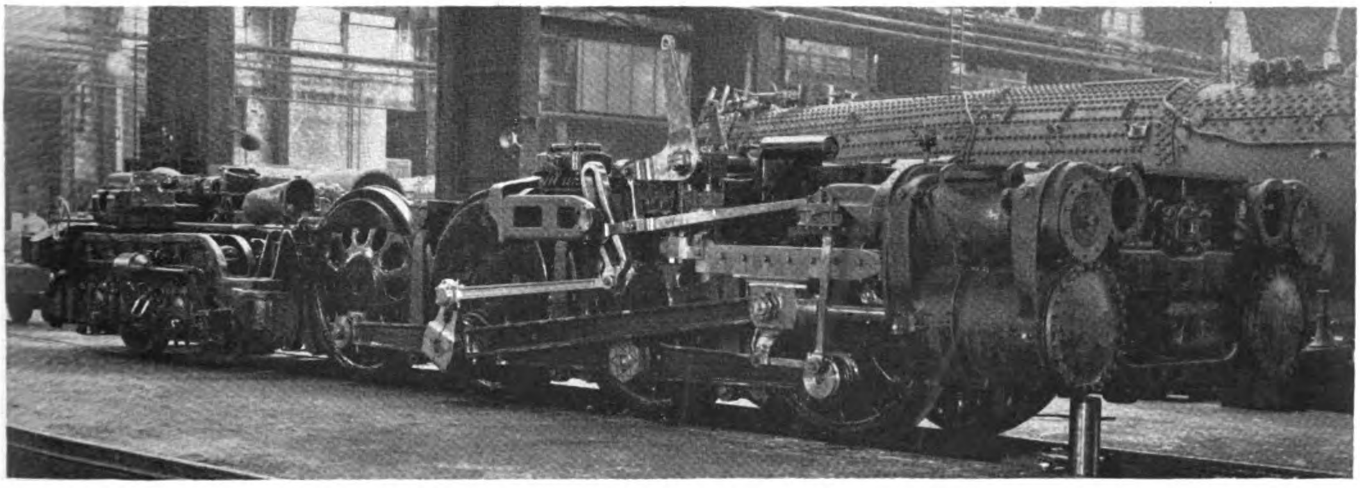


The engine truck

the ground are placed in the sides of the firebox near the throat sheet.

The Firebar grates have 15 per cent air openings. The stoker is the Standard Type MB with the stoker engine installed in the tender. The boiler feed equipment includes a Nathan live-steam injector on the right side and an Elesco exhaust-steam injector with remote control and centrifugal pump on the left side.

The exhaust-steam injector is the recently developed type TP. It is started and stopped by a simple starting valve. The amount of water delivered to the boiler is regulated by an indexing handle in the cab which is the only manual control and does not need to be moved when the injector is shut off. The operation is entirely

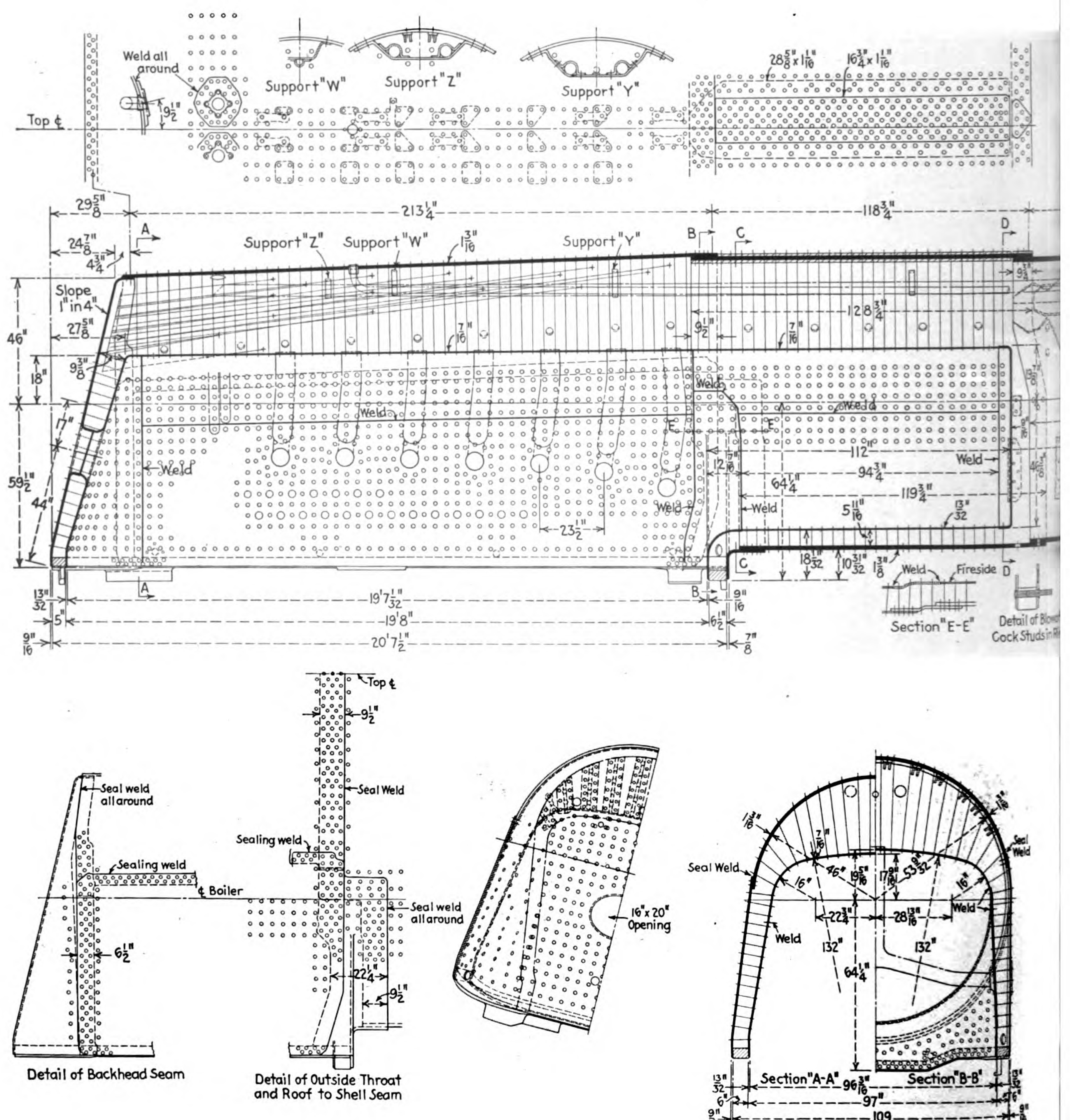


The rear engine unit in the erecting shop

automatic once the starting valve is opened. The centrifugal booster pump is added to the type TP injector so that the choice of location on the locomotive is not limited by the non-lifting characteristic of the injector itself, and on these locomotives the exhaust-steam injector is located on the left side of the smokebox.

The Type E superheater has 93 units. These units, which are inserted in 4-in. flues, are 1⅜ in. in diameter. The multiple throttle includes an auxiliary throttle, supplied with saturated steam from the dome, for drifting and handling the locomotives by hostlers at terminals. The throttle has a double quadrant and latch to permit half-notch adjustment. It provides additional head room.

The front-end arrangement consists of two complete stacks and exhaust nozzles on a common base, one for each of the two engine units. Each exhaust tip has four jets. Each stack extension includes a four-jet combining tube at the bottom which resembles somewhat the formerly much-used petticoat pipe in its relation to the stack extension proper. These jet-combining tubes comprise in effect four draft tubes, one for each exhaust jet, and the setting is such that the jet fills the tube near the top. As the exhaust jets pass into the upper part of the stack extension, further injector action is effected in the annular passage between the top of the draft tubes and the stack-extension bell.



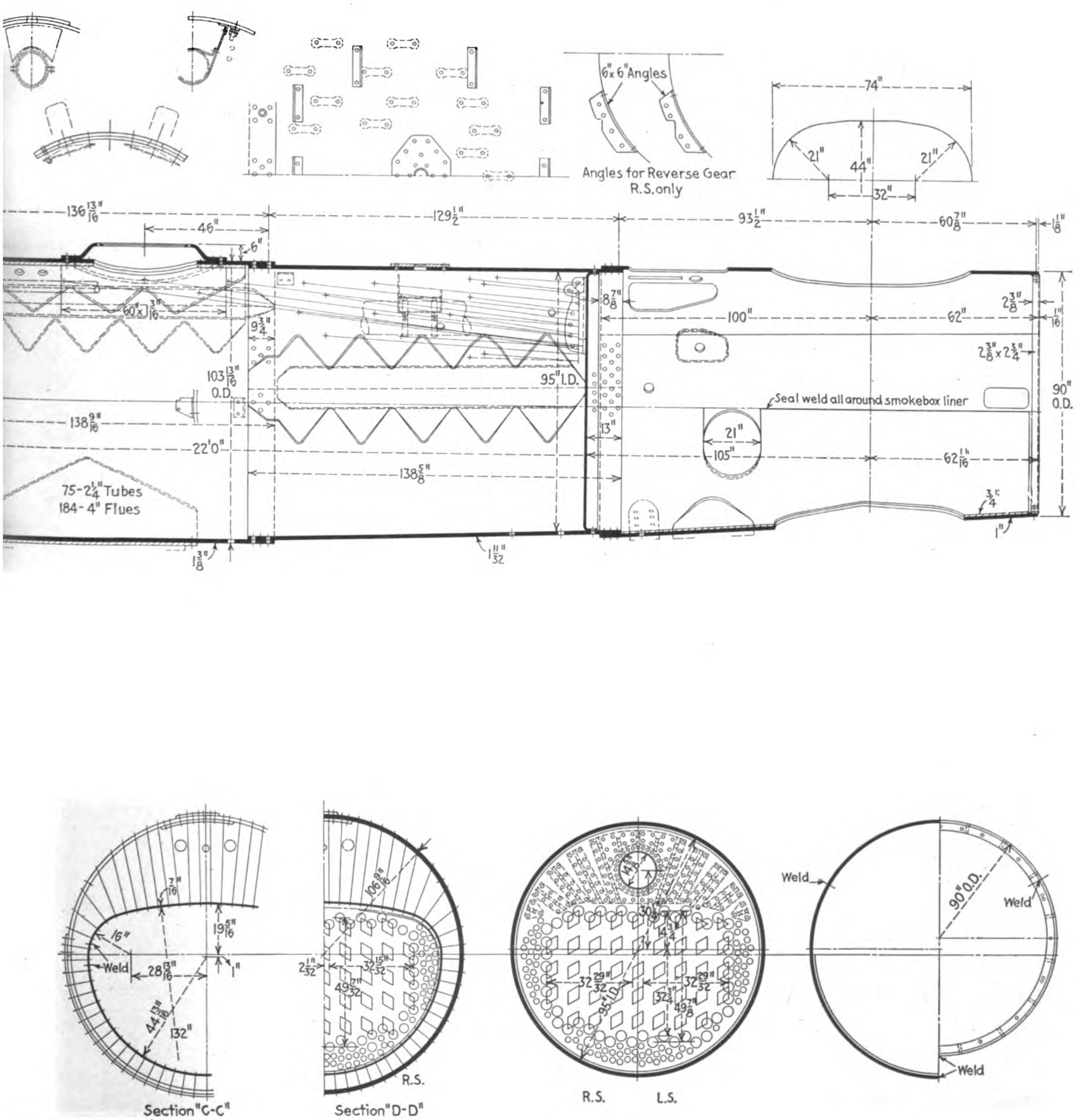
Longitudinal and cross-sections

The labyrinth front-end draft appliance is a patented device developed on the Union Pacific. Instead of the customary arrangement of table plate, the exhaust nozzles and smoke stacks are enclosed at the sides by longitudinal sheets which slope from the arch of the smokebox to the top of the exhaust stands. Thus, the gas passages to the front of the smokebox range from 96 to 112 per cent of the net gas area through the tubes and flues.

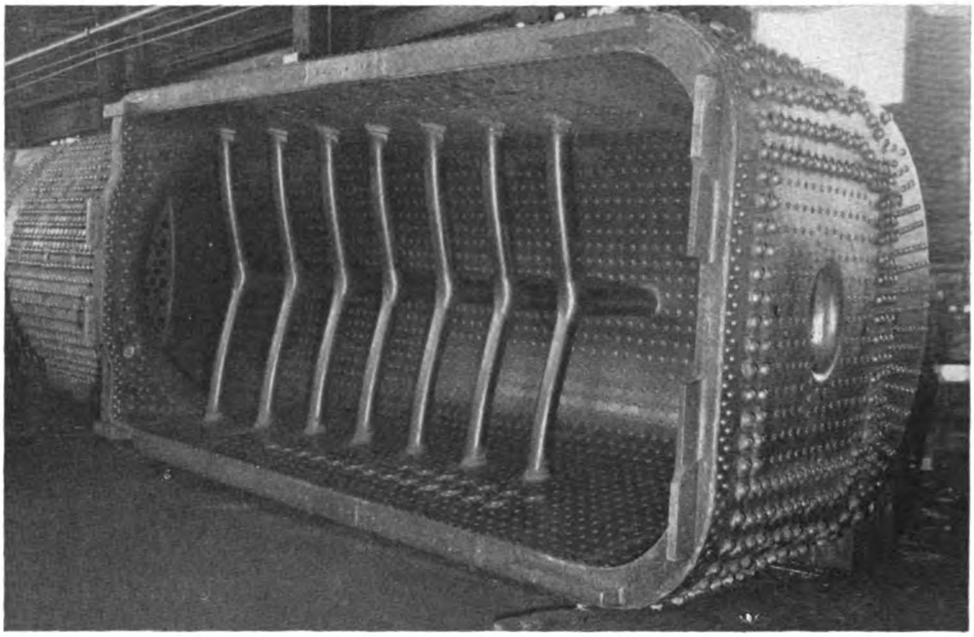
The front of the space about the stacks and nozzles is partially closed by a vertical plate, the top of which is 22¼ in. above the center line of the boiler. The gases pass through the space between this plate and the smokebox door and over its top through the area between it and the top of the smoke arch through the labyrinth draft appliance. The areas of these passages are in excess of the net gas area through the tubes and flues.

The cab is completely supported from the boiler. It is insulated with Fiberglas and lined with Masonite. It has Prime clear-vision windows with air defrosters at the front and windshield wings at the windows on each side. Both the engineman's and fireman's seats, furnished by Heywood-Wakefield, are adjustable both horizontally and vertically. There is a seat for the road foreman on the right side, and a seat for the brakeman on the left side.

These locomotives are equipped with two water



nd details of the boiler



Seven Security circulators are installed in the firebox

columns each having two standard-length water glasses, and the right-hand water column is provided with three gauge cocks. The height of water above the highest point of the crown sheet on level tangent track is 10½ in. with the water level in the boiler at the bottom gauge cock. Each pair of water glasses is applied with a vertical difference of 5½ in. in the lowest water-glass indication. The upper water glass is for indicating the height of the water in the boiler on level track or ascending grades, and the lower water glass is for indicating the height of the water in the boiler on descending grades.

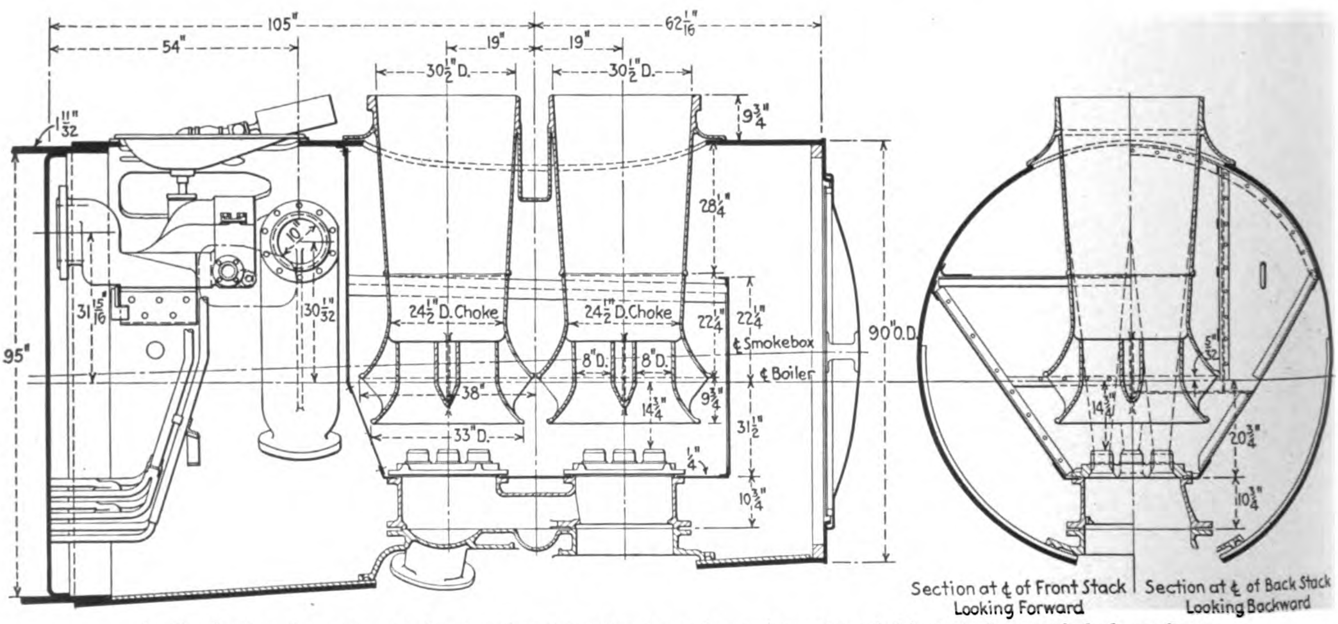
There are two saturated-steam turrets in front of the cab, one on either side. Each is supplied through a 3½-in. dry pipe from the dome. Another turret for superheated steam supplies the air pumps, stoker and turbo-generator. The whistle is also operated by superheated steam.

The air-brake equipment is Westinghouse No. 8 ET. Two 8½-in. cross-compound compressors are mounted on the front end of the forward engine bed. Each compressor is served by a mechanically operated lubricator. Shields in front of the air compressors protect the air-brake fin-tube radiation. There is 15 ft. of radiation pipe between the air pumps and a sump reservoir and an eight-tube New York Air Brake intercooler between the sump reservoir and the main reservoir. In the sump reservoir is an automatic drain valve.

Single brake heads with two flanged brake shoes per head are applied on the driving wheels. A single long brake shoe is applied on the rear of each trailer-truck wheel. The engine truck is designed for the future application of brakes. There are anti-rattler devices throughout the brake rigging.

The Pilot and Bumper

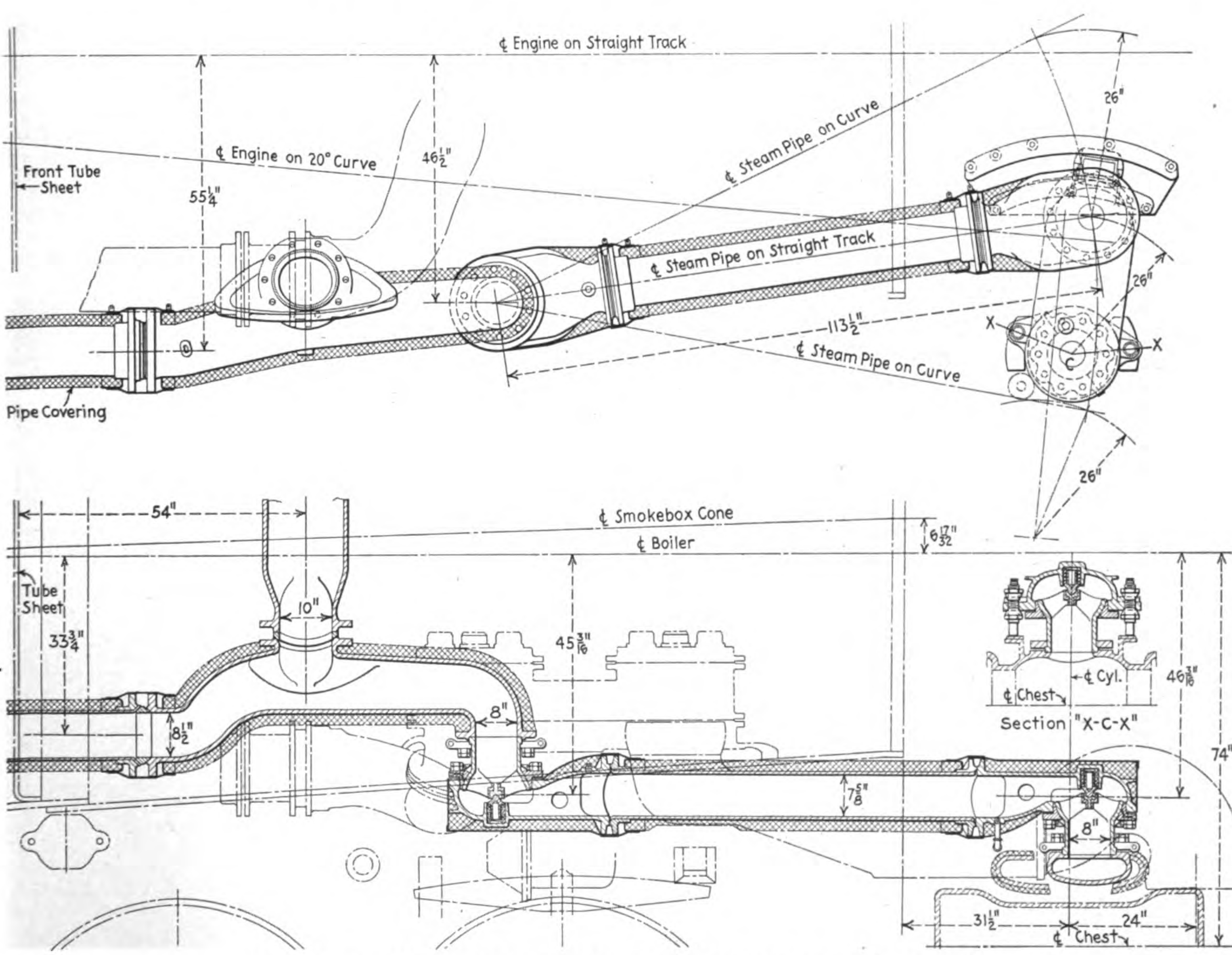
The pilot is cast integral with the front bumper beam and the latter is provided with a rubber bumper. The top section of the pilot consists of a swing-type coupler



In the front end are two stacks, two four-jet exhaust nozzles and a patented labyrinth front-end draft appliance

Partial List of Materials and Equipment on the Union Pacific 4-8-8-4 Type Locomotives

Bases, driving-wheel centers, bumpers and pilots, trailing trucks	General Steel Castings Corp., Eddystone, Pa.
Engine and trailer-truck wheels	Bethlehem Steel Co., Bethlehem, Pa. Carnegie-Illinois Steel Corp., Pittsburgh, Pa.
Lateral-motion device; trailer and driving springs; tires	American Locomotive Co., Railway Steel Spring Div., New York.
Radial buffers; frame wedges; compensator and snubber	Franklin Railway Supply Co., Inc., New York.
Roller bearings	SKF Industries, Philadelphia, Pa. The Timken Roller Bearing Co., Canton, O.
Frame equalizer bushings; shaft arm bushings	Gatke Corp., Chicago.
Engine couplers	Buckeye Steel Castings Co., Columbus, Ohio.
Brakes	Westinghouse Air Brake Co., Wilmerding, Pa.
Brake shoes	American Brake Shoe & Foundry Co., New York.
Brake-pipe conduit	United States Rubber Co., New York.
Air pump intercooler	New York Air Brake Co., New York.
Boiler and firebox plates	Bethlehem Steel Co., Bethlehem, Pa.
Tubes	National Tube Co., Pittsburgh, Pa.
Tube turns	Tube-Turns, Incorporated, Louisville, Ky.
Brick arch; Security circulators	American Arch Co., Inc., New York.
Staybolt material	Jos. T. Ryerson & Son, Chicago. Ulster Iron Works, Dover, N. J.
Flexible stays; expansion stays	Flannery Bolt Co., Bridgeville, Pa.
Rivets	The Champion Rivet Co., Cleveland, Ohio.
Fusible plugs	Nathan Manufacturing Co., New York.
Lock washers	National Lock Washer Co., Newark, N. J.
Stop nuts	Elastic Stop Nut Corp., Union, N. J.
Door hinges	The Homer D. Bronson Co., Beacon Falls, Conn.
Steam pipes; exhaust pipes	National Tube Co., Pittsburgh, Pa.
Pipe clamps	Adirondack Foundries & Steel, Inc., Watervliet, N. Y.
Pipe supports	Symington-Gould Corp., Rochester, N. Y.
Copper pipe	Chase Brass & Copper Co., Waterbury, Conn. Phelps Dodge Copper Products Corporation, New York.
Asbestos tubing	Union Asbestos & Rubber Co., Chicago.
Cylinder and boiler lagging	Johns-Manville Sales Corp., New York.
Multiple throttle	American Throttle Co., New York.
Packing	The Garlock Packing Company, Palmyra, N. Y.
Superheater pipes; exhaust steam injectors	The Superheater Company, New York.
Steam line injectors	Nathan Manufacturing Co., New York.
Foam collapsing system	Electro Chemical Engineering Corp., Chicago.
Coal sprinklers	Wm. Sellers & Co., Inc., Philadelphia, Pa.
Ashpan sprinkler valve	The Lunkenheimer Company, Cincinnati, Ohio.
Washout plugs; circulator plugs	The Prime Manufacturing Co., Milwaukee, Wis.
Hose	Hewitt Rubber Corp., Buffalo, N. Y.
Blow-off cocks	Wilson Engineering Corp., Chicago.
Feed pipe strainer	T-Z Railway Equipment Co., Chicago.
Grates	Waugh Equipment Co., New York.
Firedoors	Franklin Railway Supply Co., Inc., New York.
Stokers	Standard Stoker Co., Inc., New York.
Stoker flexible joints	Barco Manufacturing Co., Chicago.
Cab insulation; ventilators	Gustin-Bacon Mfg. Co., Kansas City, Mo.
Cab roof; side walls	Masonite Corp., Chicago.
Clear vision windows	The Prime Manufacturing Co., Milwaukee, Wis.
Shatterproof glass	Pittsburgh Plate Glass Co., Pittsburgh, Pa.
Floor plates	Carnegie-Illinois Steel Corp., Pittsburgh, Pa.
Engineman and firemans seats	Heywood-Wakefield Co., Gardner, Mass.
Seat covering	L. C. Chase & Co., Inc., New York.
Water gages; gage cocks	Nathan Manufacturing Co., New York.
Safety valves; boiler checks	Manning, Maxwell & Moore, Inc., Locomotive Equipment Division, Bridgeport, Conn.
Steam-heat gages; back-pressure gages; steam gages	Ashton Valve Co., Boston, Mass.
Steam-heat flexible joints	Franklin Railway Supply Co., Inc., New York.
Gage holders	T-Z Railway Equipment Co., Chicago.
Cocks and valves	Crane Co., Chicago. The Lukenheimer Co., Cincinnati, Ohio. Walworth Company, New York.
Whistle	Manning, Maxwell & Moore, Inc., Locomotive Equipment Division, Bridgeport, Conn.
Bell ringer	Railway Service and Supply Corp., Indianapolis, Ind.
Sander equipment	Morris B. Brewster Company, Chicago.
Headlights and headlight generator	The Pyle-National Company, Chicago.
Classification lamps	The Adams & Westlake Co., Elkhart, Ind.



There are three ball joints and no slip joints in the steam pipes to the front cylinders

The front coupler is here shown in operating position

Ball joints	Barco Manufacturing Co., Chicago.
Universal joints	Manning, Maxwell & Moore, Inc., Locomotive Equipment Division, Bridgeport, Conn.
Flexible conductor	Kerite Insulated Wire & Cable Co., New York.
Cylinder and piston-valve bushings; piston valves	Hunt-Spiller Manufacturing Corporation, Boston, Mass.
Pistons	Locomotive Finished Material Co., Atchison, Kan.
Piston-rod and valve-stem packing	Paxton-Mitchell Co., Omaha, Neb.
Rod brasses; hub liners; crosshead liners; eccentric crank liners; expansion shoe wearing plates; frame shoes; bells; steam metal	Magnus Metal Corporation, Chicago.
Crossheads	Vanadium Corporation of America, New York.
Steel for crank pins, driving axles, main and side rods, and valve-gear details	The International Nickel Company, New York.
Drifting valves	Kieley & Mueller, Inc., New York.
McGill needle roller bearings (valve gear)	Pilliod Co., New York.
Cylinder cocks	The Prime Manufacturing Co., Milwaukee, Wis.
Drain cocks	The Okadee Company, Chicago.
Reverse gear	American Locomotive Co., New York.
Lubricators	Nathan Manufacturing Co., New York.
Lubricator dividers and terminal checks	Detroit Lubricator Co., Detroit, Mich.
Alemite grease	Socony Vacuum Oil Co., Inc., New York.
Rod grease	The Texas Company, New York.
Grease fittings	The Prime Manufacturing Co., Milwaukee, Wis.
Tender:	
Frames; lateral-motion device; front truck	General Steel Castings Corp., Eddystone, Pa.
Wheels	Bethlehem Steel Co., Bethlehem, Pa. Carnegie-Illinois Steel Corp., Pittsburgh, Pa.
Roller bearings	The Timken Roller Bearing Co., Canton, Ohio.
Clasp brakes	American Steel Foundries, Chicago.
Draft gear	W. H. Miner, Inc., Chicago.
Couplers	National Malleable and Steel Castings Co., Cleveland, Ohio.
Tank plates	Bethlehem Steel Co., Bethlehem, Pa.
Steam-heat pipe covering	Union Asbestos & Rubber Co., Chicago.
Paint	E. I. du Pont de Nemours & Co., Wilmington, Del. The Glidden Co., Cleveland, Ohio. Sherwin Williams Co., Cleveland, Ohio.

furnished by the Buckeye Steel Castings Company, which, when in closed position, fits the contour of the pilot and removes all obstructions.

The Tender

The tenders are built on General Steel Castings water-bottom beds. They are carried on a four-wheel truck at the front end and five pairs of wheels mounted in pedestals cast integral with the tender bed. The equalizing system provides a three-point-load suspension. All wheels are 42 in. in diameter and have Timken roller bearings in outside journal boxes.

The four-wheel tender truck is equalized and has a roller centering device designed for 17 per cent initial and constant lateral resistance. There are no side bearings on the tender truck.

The five pairs of pedestal-mounted wheels are equalized together on each side of the tender, with one semi-elliptic spring and two coil springs over each box. The front and back ends of each equalizing system are anchored to the bed casting through double cushioning coils in tandem. Casehardened spring rigging pins are fitted in Graphitex bushings.

All five pairs of wheels mounted in fixed pedestals are fitted with the General Steel Castings centering device. This consists of rubber blocks, sandwiched between steel plates, which are inserted between the semi-elliptic spring saddles and the top of each box. The vertical guides for the spring saddle on the frame prevent lateral movement of the top of this device but do not interfere with the lateral movement of the journal boxes against the resistance of the shear distortion of the rubber. On the four forward pairs of fixed wheels provision is made for a lateral movement of 1¼ in. On the rear pair of wheels the movement is restricted to ¾ in.*

A Nathan DV-7 lubricator with eight feeds is mounted on the tender bed and driven from the stoker engine. These feeds supply oil to all tender-truck boxes and to the tender-truck center plate.

Between the engine and tender there is a Franklin E2 radial buffer. The engine and tender connections include U. S. armored rubber hose for the air-brake lines; Franklin metallic joints in the steam-heat train line, and Barco flexible joints in the stoker steam connections.

Couplers, furnished by the National Malleable and Steel Castings Company, and Miner A94XB draft gears are installed at the rear of the tender.

The principal dimensions, weights, and proportions of these locomotives are shown in a table. Another shows a partial list of manufacturers whose materials and equipment form a part of the locomotives.

* For a more detailed description of this tender design see "Union Pacific Tenders Embody Many Improved Features," page 386, October, 1940, *Railway Mechanical Engineer.*

Senate Refrigerator Car Bill.—The Senate on October 4 passed S. 2753, the so-called refrigerator car bill sponsored by Senator Shipstead, Farmer-Laborite of Minnesota. The present version of this measure would amend the Interstate Commerce Act to give shippers of fresh meats, packing house products or dairy products the right to furnish their own refrigerator cars—provided the railroads were unable or unwilling to supply proper equipment. In other words the right of the railroads to furnish the cars is protected, if they have the equipment. The bill, and a similar measure pending before the House committee on interstate and foreign commerce, was introduced following that May 5, 1939, notice wherein the Car Service Division announced the policy of reserving for railroads the right to furnish railroad-owned or railroad-controlled cars for the traffic involved.

The Buenos Aires & Pacific, a British-owned road proceeding west out of the Argentine capital, has recently added 12 Ganz-built rail-motor cars to its equipment roster. Eight of the new cars are to be used for passenger traffic, while the remaining four will be used for express and mail traffic. The cars have a maximum speed of 60 m. p. h. and a normal operating speed of 56 m. p. h. The passenger-carrying units have a seating capacity for 60 persons, while the express cars have a capacity of 10 tons. The latter are so constructed as to permit easy conversion to passenger-carrying facilities if necessary at a later date.

Railroad Division, A.S.M.E., Stages Timely Program

THURSDAY, December 4, will be the date of the Railroad Sessions at the annual meeting of the American Society of Mechanical Engineers which will be held on December 1-5, inclusive, at the Hotel Astor, New York. The morning session, which will begin at 9:30, will be followed by an informal luncheon at 12:30. The afternoon session will convene at 2 o'clock. The program for the two sessions has recently been completed by the Meetings and Papers Committee of the Railroad Division, of which W. M. Sheehan, assistant vice-president of sales, General Steel Castings Company, is chairman, under the general direction of A. I. Lipetz, consulting engineer, American Locomotive Company, who is chairman of the Executive Committee. Other members of the Executive Committee are D. S. Ellis, chief mechanical officer, Chesapeake & Ohio; John R. Jackson, engineer of tests, Missouri Pacific; John G. Adair, mechanical engineer, Bureau of Locomotive Inspection, Interstate Commerce Commission, and First Lieutenant C. L. Combes (secretary), Coast Artillery School, Fort Monroe, Va.

The program for the two sessions follows:

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Thursday, December 4
Railroad I
9:30 a.m.

Symposium on How Can Mechanical Engineering Assist Railroads in Meeting the Transportation Phases of the National Emergency?

Introductory remarks by W. A. Hanley, President, American Society of Mechanical Engineers

Keynote speakers:
W. C. Dickerman, chairman of the board, American Locomotive Company.
C. D. Young, vice-president, The Pennsylvania Railroad

General discussion

12:30 p.m.

Informal luncheon

Railroad II
2:00 p.m.

Railway Progress Report, by E. G. Young, Research Professor, University of Illinois

Forum on The Importance of Standardization of Steam Railroad Locomotives and Freight Cars and Their Greater Utilization in Freight Service

Opened by Ralph Budd, president, Chicago, Burlington & Quincy, and commissioner, Transportation Division of the Advisory Commission

General discussion

Lightweight Steel Coaches

An order of 45, of all-welded steel construction, delivered to the New York Central by Pullman-Standard — Eighty-four-foot cars seat 56 passengers each

THE New York Central has recently received from the Pullman-Standard Car Manufacturing Company, 45 new passenger coaches of all-welded low-alloy high-tensile steel construction, each having a weight of 121,000 lb.

Principal Features of Construction

The car frame is of welded girder design, made principally of U. S. S. Cor-Ten steel and sheathed on the outside with the same type of low-alloy high-tensile steel. While relatively light in gage, this side sheathing is maintained straight and true to an unusual degree by means of closely spaced channel stiffeners ¾ in. deep welded to the inside surfaces. The center sill comprises two A. A. R. Z-sections, 31.3 lb. per foot, with the top flanges joined by a continuous weld. Each side sill includes a No. 10 gage pressed member and a rolled angle. The draft sills are a continuation of the center sills and embody built-up welded construction in combination with cast-steel draft-gear stops conforming to A. A. R. specifications. The side skirts are extended at the lower portion of the sides, curving inward to complete the streamline effect and are cut away at the trucks. Hinged sections give access to underneath equipment. The roof sheets are No. 18 gage alloy steel with Z-shape reinforcements welded to the underside.

The flooring is Pullman arch-type, made of galvanized steel with Tuco light-weight floor composition applied over it. The car insulation consists of Fiberglas with latex covering, and is 3 in. thick in the floor and roof and 2½ in. thick in the sides and ends.

Draft gears are the Waughmat twin-cushion type, with National A. A. R. tight-lock couplers, having a two-pin universal connection, with cast-steel yokes. Pullman type trap doors operate in conjunction with pivoted retracting steps having Kass $\frac{1}{16}$-in. stainless-steel treads. The Pullman-Standard vestibule closure arrangement, conforming with the exterior contour of the car body, has anti-rattling supports, bracing attachments, facings, etc., and a center, top and bottom buffer stem with single coil spring. The center and outside diaphragms are made of canvas and stretched rubber, respectively.

The interior finish of the car consists of the following: wainscoting, $\frac{3}{16}$-in. tempered Presdwood; pier panels, .048-in. furniture steel; frieze panels and end finish panels, $\frac{3}{16}$-in. tempered Presdwood; partitions, ½-in. Galvanneal-covered plywood; moldings of chrome-finish steel, snap-on type; ceilings, furniture-grade steel. The doors in the car ends are of hollow-type sheet-steel

The end wall surfaces are finished with linoleum—The rotating reversible seats have individually adjustable backs—Folding foot rests add to the comfort of the end seats

One of the coaches recently built by Pullman-Standard

construction; vestibule doors are of copper-bearing steel, with Pullman two-part construction. End door locks are of the Dayton Push-Pull type, the end doors also being equipped with Russell & Erwin semi-concealed door checks with open-holder feature.

Window sash throughout are stationary and consist of Edwards double-glazed dehydrated units, with ¼-in. polished plate glass on the outside and ¼-in. polished laminated glass on the inside. Dayton continuous type basket racks and lighting fixtures in combination are installed. They are approximately 18 in. wide and 51½ ft. long on each side of the car. One lighting fixture is located over each seat, individually controlled. The racks have a nose piece of steel satin chrome finish and the balance is painted the same color as the frieze panels.

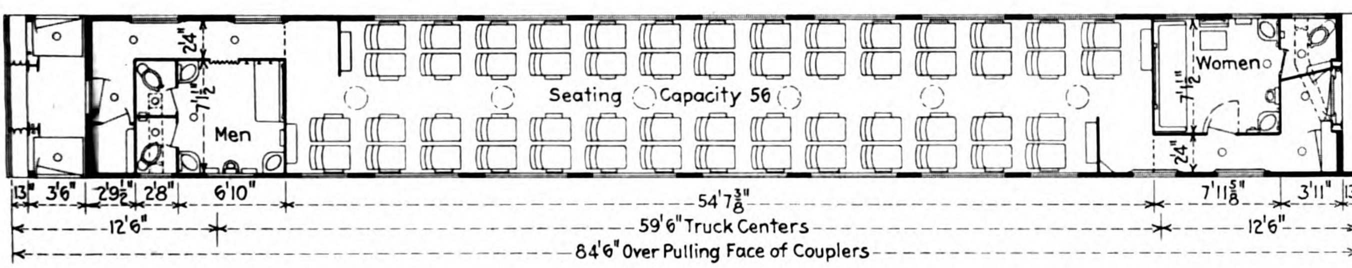
In conjunction with the general lighting scheme six combination air outlet and lighting fixtures are located in the ceiling spaced symmetrically on the longitudinal center line of the car. These fixtures are arranged with two lamps, one for general illumination and one blue lamp for night lighting.

Exhaust fans are installed, one at each end of the car; they are located over the ceiling in the toilet rooms. Exhaust ducts extend to the lavatory and toilet and at one end of the car, to the regulator locker. These fans are electrically controlled through the blower-fan-control circuit breaker so that the blower fan and exhaust fans operate at the same time.

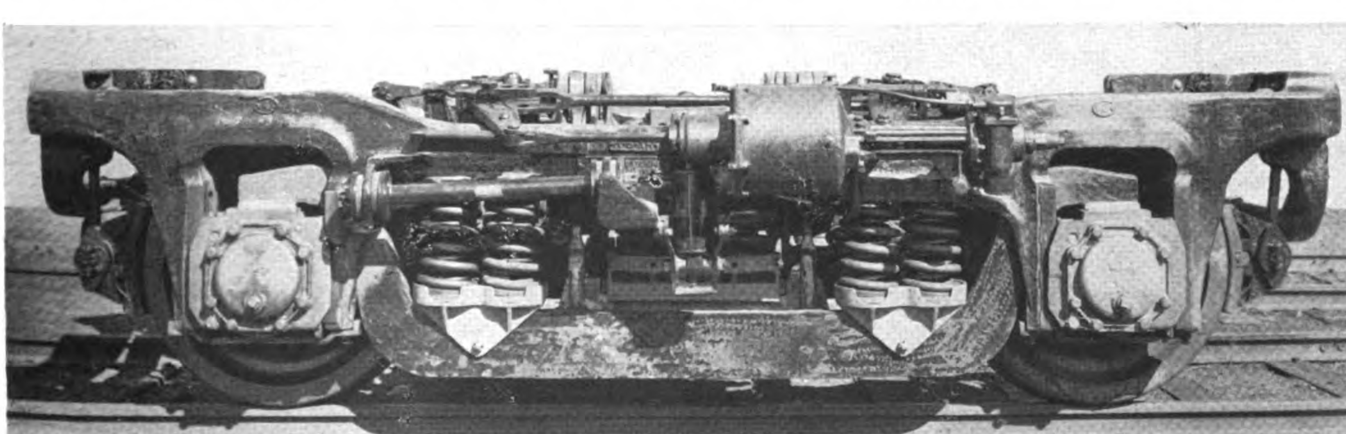
Air-Conditioning and Lighting Equipment

The air-conditioning apparatus is the electro-mechanical Frigidaire type of modulated cooling control consisting of the compressor condenser unit located beneath the car floor and the air-conditioning unit above the ceiling. The evaporator or cooling coil is divided into two parts so arranged that the 55 per cent capacity section of the evaporator cycles under the control of a differential thermostat and the 45 per cent capacity coil operates continuously with control to limit the low temperature by cycling of the compressor.

Insulated ducts conduct the conditioned air to Aerofuse combination air outlets and lighting fixtures located at the center line of the ceiling. The floor heat control panel is of the Vapor type, as is all other steam-heat equipment, including copper unit-fin type radiation and thermostatic control, on 20 of the cars. On 25 cars, this equipment is of the Fulton-Sylphon type. Vapor end valves and couplers are installed, with Barco horizontal-type insulated steam-heat connectors. The train line consists of 2⅝-in. inside-diameter seamless



Floor plan of one of the New York Central coaches



The single drop equalizer trucks are fitted with coil bolster springs and shock absorbers

steel tubing. Wovenstone insulation is applied on all steam pipes and fittings under the car.

Lighting equipment consists of a General Electric 20-kw. 80-volt generator and a 15-hp. 220-volt, three-phase induction motor, assembled as one unit and mounted on the car body with resilient mountings designed for proper weight distribution. The generator unit is driven by a Spicer drive equipped with an automatic clutch. Suitable a.c. standby receptacles permit the air-conditioning equipment to be operated at stations and terminals, and d.c. charging receptacles are available for charging the Gould 32-cell 600-amp.-hr. batteries. Lamp regulators are of the Safety carbon-pile type, with the regulator set at 60 volts at the center of the lamp load.

Air brakes are the New York Schedule H. S. C. with D-22 control valves, providing for the future application of electro-pneumatic and speed-governor control. Two 12-in. by 10-in. cylinders per truck are installed with an automatic slack adjuster for each cylinder. The hand brake is Peacock.

Details of the Truck Construction

The trucks are of the General Steel Castings four-wheel, single drop-equalizer type, with a 9-ft. wheel base. Simplex unit-cylinder clasp brakes are installed and designed to develop 250 per cent braking power when needed. The bolster and equalizer springs are of the coil type supplied by the Crucible Steel Company. The axles, with 5½-in. by 10-in. journals, are designed for the application of roller bearings, 35 of the cars being equipped with Hyatt bearings and 10 with Timken roller bearings. All journal boxes are supplied with stench bombs to warn of overheating. The Carnegie-Illinois wheels are 36 in. in diameter, solid wrought carbon-steel type with 11-in. hubs and toughened rims.

The truck center pins are of the Miner locking type, 4 in. in diameter, roller side bearings also being of the Miner type. Shock absorbers on all trucks are of the one-way vertical type. Houde shock absorbers are used on 25 cars and Monroe on 20 cars.

Sound deadening pads consist of bolster stops made of rubber vulcanized to steel plates, spring-plate stabilizing cushions of the same construction and equalizer-spring sound-insulation fillers made of Fabreeka. The truck center plates are of cast steel, machined on the inside, at the bottom bearing surface, and at the flange edges to fit between retaining lugs on the bolster. The center plates are sealed to dust and lubricated.

The Interior Facilities

The main passenger compartment in the center of the car, slightly over 54½ ft. long, has 28 double rotating reclining seats, spaced at 3 ft. 5½ in. centers and giving a total seating capacity of 56. An 8-ft. women's lounge in one end of the car has a four-seat sofa, a dressing mirror and table, and the usual complement of toilet facilities. The men's room in the other end of the car is 9½ ft. long and includes a two-seat sofa. Two toilets adjoin the men's room.

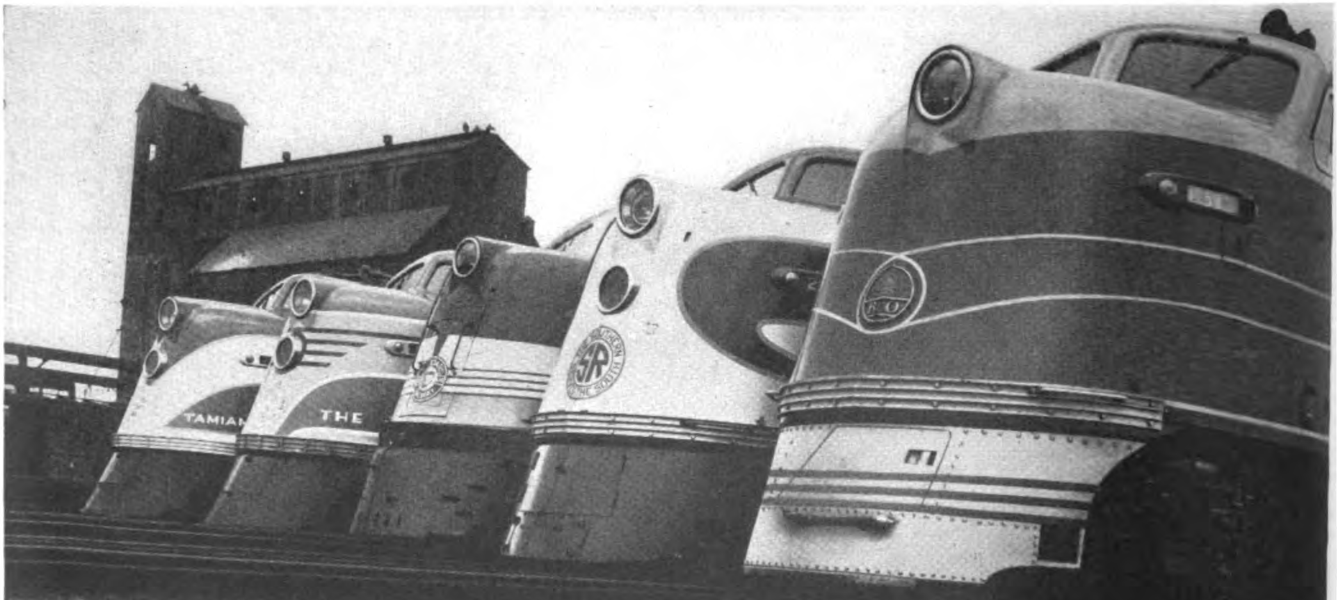
The double rotating reclining seats, supplied by the Coach & Car Equipment Company, have foam rubber cushions and folding foot rests. The Massachusetts mohair plush seat covering is turquoise in color with horizontal stripes. The sofa in the men's lounge, made by Karpen Brothers, embodies spring and hair construction with a reddish-tan leather seat covering. In the women's lounge the Karpen full-length sofa has a two-piece seat cushion with one-piece back.

Long mirrors are installed on the toilet entrance doors and wall mirrors at the washstands in the lounge rooms. On the bulkheads in the main passenger compartment mirrors are set in 26-in. by 36-in. metal frames. An electric water cooler is installed in the car with the overhead cooling unit located above the ceiling in the women's lounge and the water-spigot alcove built into the low bulkhead at the women's end of the car.

The decorative treatment and color scheme for these coaches was developed by Henry Dreyfuss. The colors range from deep tones of egg plant at the bottom through rust to gray with blue-green upholstery. Linoleum is used as a wall covering for the end partitions.

The new coaches are designed with a coupled length of 84½ ft.; length, center to center of trucks, 59½ ft.; height, rail to roof, 13½ ft., and width over side sill, 10 ft. Each car body weighs 81,600 lb., and the two four-wheel trucks, 39,400 lb., or a total of 121,000 lb.

* * *



Diesel-electric passenger locomotives of the F. E. C., A. C. L., S. A. L., Southern, and B. & O., respectively, lined up at Washington, D. C. —Built by the Electro-Motive Corporation

How to Have

Effective Safety Meetings*

By L. G. Bentley †

Experience of the Chesapeake & Ohio with Safety Committee organization and methods of conducting meetings — Employees and supervisors both active in the work

I HAVE little or no knowledge of the manner in which safety meetings are conducted on other railroads. I do know how they are conducted on the Chesapeake & Ohio and you will therefore pardon my seeming partiality to the type of meetings we have found most effective, without material change for the past 28 years.

I prefer to be specific rather than general, and for that reason I shall describe a meeting held at Huntington, W. Va., on September 11, upon which occasion I was a visitor and because of my attendance and to enable me to speak to them jointly, four committees were consolidated into one meeting.

These committees were from the locomotive and car department, terminal shops, and stores department.

The attendance comprised 11 supervisors, 22 rank-and-file men, 10 apprentices and 21 visitors. One representative was present from each shop craft on each committee.

In the mechanical department, the representatives of the rank and file are chosen through nomination by the appropriate labor organization of two candidates, one of whom is selected by the chairman. The terms of supervision are permanent and of the employee representative, one year. All meetings are bi-monthly and on company time.

The divisional and terminal meetings consist of a considerably larger proportion of supervisory officers with the ranking divisional officer as chairman and a representative from each of the labor organizations proper to be in a divisional or terminal committee.

Employee members in the shops and stores are taken from their work for the length of time necessary to conduct the business of the meeting and they then return to their regular work without loss of pay.

In the divisional meetings if necessary to relieve employee representatives from their regular work, this is done, and they are paid in full for any time lost and reimbursed for necessary expenses.

I think you will get a better picture of committee organization and activity from the order of business.

Attendance is compulsory unless prevented by illness, death, attending court or other unavoidable causes; being "assigned to important duties" is not an excuse.

No substitutes for absentees are permitted as the regular members are carefully selected and expected to take active part in the work, particularly between meetings.

Unsafe Practices Reports

Committee members are giving special attention to the correction of unsafe acts and presentation of these reports is the first order of business.

Each committeeman is furnished a book containing five unsafe-condition reports and 20 unsafe-act reports. We call the unsafe-acts reports "yellow slips" and an example of the manner in which they are used is the following slip turned in by a machinist on the day the act was observed:

On September 5, 2:40 P. M., in the electrical shop, I observed Machinist Bode Wilkins standing unsafely near and walking under engine truck being lifted by overhead crane. I spoke to him regarding this act and he promised that it would not be repeated.

At the particular meeting to which I refer, the committee members turned in a total of 391 of these reports.

Our instructions as to the manner of handling these reports are that a few hours before the meeting is called the secretary shall organize the yellow slips and report on them in summary.

A section of the secretary's report follows:

Standing unsafely near material being lifted, two reports by Messrs. O'Connor and Bias.

Using hands to clean chips from machinery and drills, one report by Mr. Hinerman.

Throwing or dropping material from overhead, two reports by Messrs. Hinerman and Bias.

Leaving tools, material or rubbish in aisles or passageways, eight reports by Messrs. Bostic, O'Connor, O'Neil, Greene, Hinerman and Diehl.

Using tools or machinery in an unsafe manner, thirty-one reports by fourteen separate members of the committee.

The efficiency of handling these reports in this manner is seen in the fact that the entire 391 unsafe practice reports were reviewed impressively in a period of 15 min.

We require supervision to give the name of the employee observed. Employee members are not required to give names but are encouraged to do so, and are gradually understanding the importance of this feature and are giving the names.

A boilermaker, in meeting, recently submitted a yellow slip reading like this: "On August 21, in the machine shop, I observed three apprentices, using compressed air to blow dust off their clothing. I corrected them and was surprised to know that none of them knew of the danger of this act."

Discussion of this report developed that there were several members of the committee who were also ignorant of the purpose of the rule prohibiting this practice. This adds value to the use of unsafe-practice reports, as each member of the committee is refreshed as to the rule and its purpose.

No discipline is applied to any one observed by a fellow employee and covered by such a report.

In advance of each meeting, the secretary prepares the unfinished business in such form that he can speedily cover this feature, giving the status of each suggestion which was outstanding at the last meeting and, if

* Paper presented at a meeting of the Steam Railroad Section of the National Safety Council, held at Chicago, October 7 to 9, inclusive.
† General safety agent, C. & O., Richmond, Va.

necessary, inquiring of the originator as to its status.

The secretary prepares in advance a statement of suggestions received and handled since last meeting. This statement includes the suggestion in full together with the action taken thereon. If advice is required as to further attention, it is secured from the proper member of the committee when this report is read.

The four committees in question, during the nine months ended September 30, 1941, turned in a total of 421 suggestions of which 396 were corrected promptly, only three were found improper, while but 22 were pending at the end of the period. This speaks eloquently for the reasonableness and the good judgment of the committee members and for the promptness with which management is disposing of these matters.

If for any reason a suggestion is declined, a personal letter is written by the chairman to the originator of the suggestion, in which proper explanation and expressions of appreciation are made.

In the shops, an Inspection Committee of two members, alternating from time to time, is sent out during each week without warning and required to spend one hour inspecting. During the nine months in question, inspection committees, representing the four safety committees under discussion, devoted 221 hours to this work and turned in a total of 246 suggestions, which was a substantial part of the total of 421 turned in by the committees as a whole.

Discussion of Accidents

The committee we are discussing was in session 1½ hours, of which time one hour and twenty-five min. were devoted to accident prevention discussions and 5 min. to a discussion of accidents that had occurred during the last two months.

Lest you get the idea that the large number of unsafe practice reports made by committee members at this meeting indicates an extremely careless, dangerous operation, I hasten to correct this impression as there has not been a reportable injury in this entire plant this year, although nearly three million man hours service have been performed.

The facts are that an organization of supervision and safety committeemen can enter any of the shops on our railroad, and I believe on any other railroad in the United States, and if they are as keenly alert as intensively interested in accident prevention as the members of this particular committee are an equal or greater number of unsafe-practice reports will be brought to light.

By means of a monthly circular which we call our "Safety Digest," the chairman of the committee then makes a report as to progress. As a matter of fact, however, the interest in this particular shop is so keen that almost everyone knows the status of the organization in connection with their accident record.

For the nine months period, this committee received a total of over 2,000 unsafe-practice reports. The entire cost of taking these men from their jobs and consulting with them as to accident prevention measures amounted to $151.60, or an average for the 22 rank and file committeemen of $6.80 each for nine months work.

An important feature of the efficiency of this committee is seen in the fact that both the reports of unsafe conditions and unsafe practices are submitted by the committeemen between meetings so that immediate action may be taken thereon.

As to the expense for holding safety committee meetings over the entire system, in accordance with our plan of paying committeemen for their lost time and expenses, I find that in nine months 173 safety committee meetings were held; the attendance consisted of 1,306 officers and 1,001 employee representatives, and the total expense on all accounts amounted to $2,357.95.

If you can show me a plant by which $2,357.95 can produce a better spirit of cooperative endeavor than that which is clearly demonstrated by our safety committees, I would like to know of it.

As I thought about this subject and as I reviewed our past experiences and prospects for future progress, I thought of three lines taken from Tennyson's "The Charge of the Light Brigade"—

"Their's not to reason why
Their's not to make reply
Their's but to do or die."

I am not at all sympathetic to a plan that seeks cooperation of the worker through fear of punishment, nor by a totalitarian method of conducting the program.

In further expression of this conviction on my part, I feel justified in quoting from my remarks at New Orleans, La., last May when I spoke on "The Future of The Safety Section."

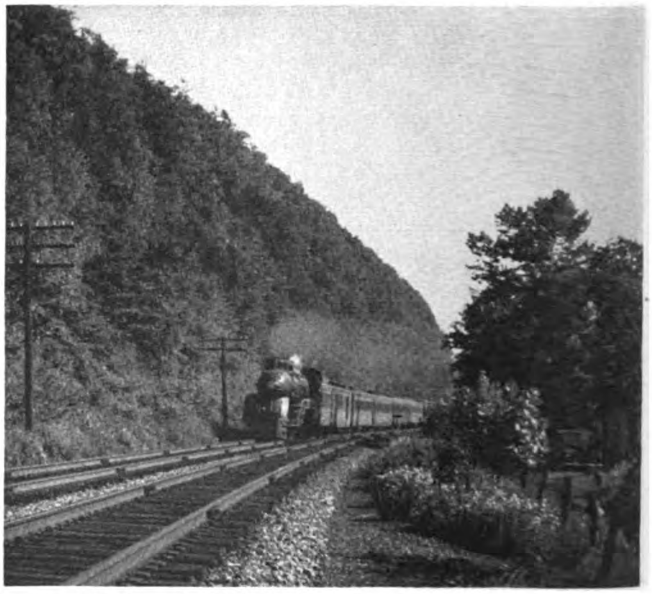
"The rank and file of employees are those who have the greatest stake in the safety movement, because they are those who suffer most when an injury occurs, and because they have this stake they should have a distinct and active part in the prevention of accidents.

"We have found our safety committees, comprising officers and employees, great builders of esprit de corps, not only in safety but also in reaching a better understanding between officers and men as to matters of other mutual interests.

"Safety rules and their enforcement have become a necessary part of a good safety organization, but unless the individual rank and file employee in some way has a part in the safety program, he will daily commit acts of hazard that cannot be defined or covered by a safety rule.

"In carrying out a desire to win the active support and cooperation of a person, no better way can be found than to give him something to do. I am sincere in saying that the rank and file of employees must be given a faith in the integrity of our safety program, must believe that it is in their interest to enter that program actively, and the only way that they can be given this conviction is to give them a part in the work."

* * *



Courtesy of W. Curtis Montz

The "Black Diamond" near Ransom, Pa., on the Lehigh Valley

The Cure for

Plugged Front-End Nettings

Report of a committee presented before the Railway Fuel and Traveling Engineers' Association in September relates unsuccessful attempts to determine the cause, but is in no doubt as to the cure: get rid of the netting

THE Committee on Stopped-Up, Plugged, or Slagged-Over Front-end Nettings, Cause and Cure of the Railway Fuel and Traveling Engineers Association, of which H. L. Malette, road foreman of equipment, St. Louis-San Francisco, was chairman, made a collection of opinions as to the causes of plugged front-end nettings which were not at all in close agreement. It also reported on a series of standing tests conducted on the St. L.-S. F. by the chairman, in which attempts were made to reproduce conditions which were thought to have caused front-end nettings to become plugged in service. These tests included several combinations of conditions of the fire with varying sequences of heavy and light firing and of open and closed throttle, and with water sprayed into the front end. In none of the tests, however, was a case of plugged front-end netting successfully induced.

The tests were run with a washed nut coal with not over 10 per cent of fines less than ½ in. It formed coke banks but would not clinker, not even when the fire was stirred with the hook. The coal was low in ash.

The report then undertakes to set forth the conditions and sequence of operations which are believed to cause plugged netting, even though it is impossible to plug the netting artificially by attempts at reproducing these conditions, and then discussed the cure on which the report speaks much more positively than in the attempt to explain the cause. These two portions of the report appear in abstract below.

What Causes Plugged Front-End Netting?

Front end defects contribute to the plugging up of nettings only because they are the factors that caused the engine not to steam as freely as it should. This then leads the fireman to crowd his fire to maintain steam pressure. The crowding of the fire results in a bad fire condition, such as banks or clinkers, with poor distribution of air through the fire bed, causing the draft to be excessive through some parts; or if no banks or clinkers, the firebed will be too heavy, resulting in heavy distilling off of the volatile gases, which will lack oxygen to burn completely when the throttle is closed or eased into drifting position. These will be carried over through the flues into the smoke box with the fine, dusty ash and cinders and when entering the lower temperature zones in the smoke box, they will condense back into a tarry liquid or plastic state.

When condensation of these gases takes place, countless minute drops form throughout the gas. These become larger as the gases shrink and the drops are drawn together. Some of the tar strikes and clings to the netting, picking up more tar, ash dust, fine cinders and soot, building up and closing over the netting. Larger cinders become imbedded and wedged in this deposit and are held there by the draft. Water cannot exist as a liquid in temperatures and vacuums present in the smoke box but is steam and is not what causes the netting to plug up. This condensation of tar does not start to form over the netting at all points at the same time; it starts at the coolest part, which is at the top of the smoke box out of the direct flow of the hot gases entering the smoke box. This point is at the top ahead of the stack where the netting is attached. This accounts for the netting always plugging over at the top first and progressing down; as the netting covers over, it retards the draft and cinders cannot be carried up to the netting and they pile up and fill the front end ahead of the table plate and nozzle below the netting.

Now all this has so reduced the draft that maximum steam pressure cannot be maintained and the front end will have to be opened and cleaned, resulting in a delay. When the front end is opened it will not be a sticky substance you will find as the tar soon hardens to a brittle sort of pitch covered with ash, soot and cinders. It has a dull, charred appearance. Strike the net netting a blow with a hand hammer with the blower closed and it is dislodged and falls down, leaving the netting clean.

This condition can start in a different manner. We will say some defect has made the engine steam poor and the fireman has crowded the fire, or he has no defect but the coal supplied was wet and hard to distribute. and banks and clinkers form; the draft becomes heavy in spots and particles of unburned coal are pulled off the banks or are taken up with the excessive draft, partly burned, and pulled over the arch, through the flues and into the smoke box in a plastic state, sticking to the netting, where the temperature of the smoke box further distills off the lighter volatile gases, leaving the fixed carbon with some of the heavier gases cooled down to a solid brittle tar or pitch. Now this occurs where the coal is a coking coal. We have all seen coal that swells up as it burns, or cokes. The heat is roasting out the volatiles. During this roasting out, a gas or coking coal does become plastic and sticky. Under conditions such as this there is also ash dust, fine cinders and soot forming on and around the cinders on the netting, closing off the draft and lowering the firebox and smoke box temperatures, resulting in a condition being set up where unburned gases condense and complete the plugging.

"Sweating" occurs as the fire is built up in a cold engine or one that has stood with low steam pressure, and the front end sheets, stack and netting are cool; the fire is built up heavy, with blower pressure low, the coal is high in moisture or wet. Under these conditions the fire burns red and smoky, the boiler takes up as much heat as possible, the smoke box gases are at a lower temperature than usual; the water in or on the coal becomes steam but condenses back into water when it comes into contact with the cold front-end parts. In all coals there is some sulphur. The water vapor and steam condensing takes up considerable of the sulphur

vapors. As the drops form on the top of the smoke box and get heavy, they break away and roll or flow down the netting through a path of soot, ash dust and fine cinders, which, being dry, will quickly absorb water and a thin, ash liquid is formed that bridges over the opening between the meshes of the netting, closing off the draft until there is only a small percentage of the netting open, usually at the bottom where the gases pass through at a temperature that will keep the water in the form of steam while passing through and out the stack.

As the pressure in the boiler raises or the front end sheets warm up, and blower pressure becomes stronger, the sweating stops and the front end dries out, but left on the netting is the soot, cinders and ash dust, closing over and restricting the draft. Now a condition is set up which causes a poor steaming engine, the fireman crowds the fire, and as explained before unburned gases, carrying over tar, complete the job started by the sweating and a front end needs cleaning.

The same conditions can be set up that were started by sweating; that is, when an engine has stood with cylinder cocks closed or channels not drained, and valves and cylinders cold, in first starting the engine, if this water has not been blown out the cylinder cocks and the cylinders and valves warmed up, the first few exhausts on starting the engine will not be strong enough to raise the water up and out the stack. The water runs over the top of the nozzle tip into the smoke box, where it evaporates into a highly saturated steam which condenses at the top of smoke box and runs down the netting. Or, the same conditions can be set up where house blowers are not drained before being turned on at the engines, causing water vapors highly saturated to condense on the netting, with results as explained above.

The Cure

The cure-all that is really a cure is to remove the cause; that is, the netting. There are front ends now on the market that do not use nettings, and I am told they are very successful; in fact, I have had experience with two of them.

Second: Teach the roundhouse forces such as firebuilders, engine watchmen and hostlers to avoid having any accumulation of water enter the smoke box when firebox and front end temperatures are low; to drain house blower lines before using, opening cylinder cocks and cracking throttle, and to always reverse the engine a couple of times with the throttle cracked before moving to insure that all water has been expelled and valves and cylinders are warm; not to force fires, making dense smoke, but to build fires and fire so as to keep down smoke with as bright a fire as possible.

Third: Enginemen should be taught to cooperate with each other and avoid wasteful firing practices by keeping fires free of banks and clinkers, supplying fuel to the fire bed only as it is needed. Grates should never be shaken while the engine is working heavily, nor should heavy banks of green coal be stirred up with the rake while the engine is working heavy. If a fireman knows his job and has been observant he can quickly tell, when using the blower with the throttle closed, by the condition of the fire at the time and the amount of blower being used, the length of time it takes to raise pressure under normal conditions. If the fire is average and the blower used is heavy, and steam pressure lags and raises slowly, it is an indication to him that some restriction to draft has occurred. It will be in the front end—the netting partly stopped up, or a bad leak in blower line in the front end, or a unit leak with front end throttle—but this can be tested by closing the blower, with the throttle closed, and a leak sufficient to affect the steaming can be detected by sound. Many times a change in front-end design, sealing of arches, change of grates or the installing of a hot-water wash-out plant has cleared up a division that had trouble of this nature.

My own opinion, and not the opinion of the committee, is:

On the modern locomotive with large grate areas on which the coal burned does not exceed 180 to 200 lb. per sq. ft. per hr., having combustion chambers and flues longer than 17 ft. with arches sealed at bottom and of the proper height so that the flameway or path is long, with grates that will produce an even distribution of air and not require banks to keep the fire on certain sections of the grate, a netting is not required, as the cinder that the draft can raise up and carry over the arch through the high temperatures of the combustion chamber will pass through the flues smaller than the size of the mesh in the average netting. If the cinder isn't smaller, then you have a wasteful engine, high in stack losses or improperly drafted, fired or operated.

Discussion

J. Fahey (N. C. & St. L.) inquired whether the plugging of netting might not come from leaks in the hot-water down pipe from the front-end feedwater heater. The author answered that the feedwater heater pipes are in a recess quite separate from the smokebox.

S. R. Tilbury (A. T. & S. F.) said that plugged netting had formerly been a prolific source of delays. He said that this condition usually arose when the locomotive was about half way over the road, and that it occurred more frequently with good nut coal than with other fuels. He said that they had never succeeded in reproducing the conditions which caused the netting to plug. In no case, he said, had leaks been found in the front end of engines on which the netting had plugged and he also called attention to the fact that the feedwater heater pipes are in enclosed recesses entirely outside the smokebox space.

He cited one situation in which it was customary to shake the grates immediately after changing engine crews and while working the engine hard at about 20 miles an hour up a heavy grade. While this practice was followed, steam pressure would immediately drop back and it would be necessary to clean the front end and the netting, after which the trip would be continued successfully. He said that stopping this practice had overcome the difficulty.

Mr. Tilbury cited other specific instances of trouble from plugged front-end netting. The cure, he said, is the elimination of netting from the front end and stated that a satisfactory front end without netting had been developed by the Santa Fe test department.

A speaker from the New York Central told of both standing and road tests in which efforts had been made to cause front-end netting to plug up by the admission of water to the front end through a ½-in. hose connection. He said that throughout the range of tests in which varying amounts of water were admitted no trouble had developed. He also cited instances in which efforts had been made to reproduce the other conditions which on one trip had caused the front-end netting to become plugged but without success.

In closing, Mr. Malette emphasized, what had been stated in the report, that, with front-end temperatures of 500 deg. F. and higher, and a high vacuum, water can exist in the front end only as superheated steam and that it is not the cause of plugged front-end netting. He admitted frankly that he was still in the dark as to the real cause.

EDITORIALS

Safety Efforts Worth Paying For

Although nearly three million man-hours service were performed during the first nine months of this year in the Huntington, W. Va., shops of the Chesapeake & Ohio, there was no reportable injury. There must be excellent reasons behind a record of this sort. L. G. Bentley, general safety agent of the system, told how it was accomplished in an address before the Steam Railroad Section of the National Safety Council meeting in Chicago last month. His address is reported elsewhere in this issue.

In the first place the Chesapeake & Ohio has persistently and consistently carried on an aggressive safety program for many years. The organization is not only safety conscious, but the movement is so organized that the committees are continually on the job. No excuse, for instance, will be accepted for absence from a committee meeting unless it is absolutely unavoidable. More than that, the committee members at the shops hold their safety meetings during working hours and not on their own time or at their own expense. Employee representatives relieved from their regular work to attend divisional meetings, are compensated for the time lost and are reimbursed for necessary expenses. The railroad, however, feels more than compensated for this expenditure by the savings resulting therefrom.

While the railroads in general have greatly improved their safety records over the years, there are still too many accidents to employees. Some roads consistently maintain splendid safety records; others are just about as consistent in remaining near the bottom of the list, or far from the top. If some roads can do a good job in this respect, why not all of them?

President Roosevelt, when he recently issued a proclamation calling upon the National Safety Council to mobilize the safety forces to reduce accidents in this country, directed attention to the fact that in the year 1941 100,000 lives will be lost because of accidents. Moreover, hundreds of thousands of people will lose a considerable amount of time from their occupations because of accidents, or they may be permanently maimed.

Colonel John Stilwell, president of the National Safety Council, has estimated that the economic loss due to accidents in the year 1941 will approximate three and a half billion dollars. The effect of accidents on our national defense program, in which railroad transportation is intimately involved, is an exceedingly serious factor.

It is, of course, unfortunate to have to make an appeal for safety on an economic basis, when so much suffering is involved and humanitarian instincts should govern. The economic measuring stick, however, does give some idea of the tremendous losses suffered in that category, and with humanitarian objectives, should spur us on to the greatest possible endeavor to reduce and eliminate accidents.

Prize Competition Commended

The announcement in the October *Railway Mechanical Engineer* of the contest for the best articles on ways and means of improving the mechanical department's operations or practices to increase production and secure a larger use from the equipment and facilities, has met with a fine reception on the part of railroad mechanical department officers. Some of them have indicated a desire to publicize the contest on their own systems, and requests have thus far been received for about 4,500 copies of the announcement for distribution by these officers. Such action and co-operation speak for themselves.

Some questions have been asked about the contest. For instance, one man has in mind describing certain improvements he has made in shop practices, which have resulted in increased production and lower unit costs. He wants to know if such an article would be acceptable. Naturally the time element is involved. Will the improvements he has in mind bring about fairly prompt results, or will it take a long time to realize their full value? We are in a period of national emergency and the sooner results can be obtained the better. That factor obviously will be involved in the judges' decision.

Should photographs and drawings accompany the article? Yes, particularly if they are necessary to make the suggestions clear.

The contest closes on January 15, 1942.

Flexibility and Stability In Articulated Locomotives

The problem of adapting the long driving wheel bases of steam locomotives to track curvature has been the subject of a variety of treatments during the history of steam locomotive development. In early attempts at utilizing long coupled wheel bases, wide-faced flangeless tires were applied to the main and intermediate drivers with flanges on the end pairs of wheels. Then came the use of varying gage distances between the backs of the flanged tires on the several pairs of wheels to provide for greater lateral movement of the end pairs of driving wheels within the track gage. This and the

free lateral movement of the axles in the driving boxes permitted the adjustment of eight and ten coupled wheel bases which kept the locomotive on the track even though it did not provide for smooth movement of the locomotive around curves.

About 25 years ago the idea of providing controlled lateral movement of the locomotive axle against a predetermined resistance in order to reduce the length of the rigid wheel base to an amount less than the length of the coupled wheel base was developed and utilized on locomotives with both eight and ten coupled wheels. In recent years the application of this principle to more than a single pair of driving wheels has begun to take hold until the principle of a completely flexible wheel base has now been put to the test and found to give good results in service. Applied three years ago on an order of 4-8-4 locomotives for the Union Pacific, it has now been carried out completely on an order of eight-coupled articulated locomotives for that railroad, a description of which appears elsewhere in this issue.

As applied on these locomotives, all wheels are fitted alike to the track gage, there being no variation in the distance between the backs of tires on any of the locomotive wheels. With the rear pair of driving wheels on each engine unit installed without lateral and serving as the pivot for the curving of the locomotive, all other driving wheels and the four-wheel engine truck are free to adapt themselves to the curvature of the track against fixed initial lateral resistances. With these resistances suitably selected the locomotive adapts itself to the curvature of the track with a cushioned build-up of the guiding resistances so that the steam locomotive actually follows the course of the curves instead of passing around it in a series of chords with more or less violent changes in direction from each one to the next. The smoothness of action of the locomotive thus permitted on curves exerts a beneficial influence not only on the effect of the locomotive on track but on the wear of the locomotive running gear as well.

But it is not alone in curving that this extension of controlled lateral movement to the entire wheel base of the locomotive is beneficial. The control of lateral in curving permits the absence of undesirable free lateral on tangent track. This steadies the motion of the locomotive and this also should be reflected in less wear and tear on the running gear.

Another refinement in the running gear design which has been coming into use during recent years is the application of coil springs between the ends of the fixed spring hangers and the locomotive bed and trailer-truck frame. This is of particular importance in locomotives with long wheel bases such as the articulated locomotives described in this issue and permits changes in the effective length of these hangers which otherwise would remain constant. Adjustments in load distribution are thus facilitated, particularly on vertical curves, without the extremes of unloading and overloading which otherwise would take place in passing through such curves.

Both of these features are doing much to make the long wheel-base articulated locomotive a highly flexible but completely stable machine.

Where Is The Excess Capacity?

Surveys have been made, from time to time, which indicate that the repair shops of American railroads rank with army arsenals at the bottom of the list in the matter of the antiquity of machine tools and shop equipment—based upon the percentage of the total number of machines of 10 years old and older—over 80 per cent of the tools in railroad shops being beyond the 10-year mark. It is rather difficult to understand the managerial philosophy that permits the plant of a vital industry to reach such a state of obsolescence with respect to its important machine units.

Before the present emergency arose the army had a perfectly good excuse—several of them, in fact—for the condition in the arsenals. The principal one, however, was the fact that when an emergency arose the major part of the burden for producing the material and munitions of war could be turned over to private industry. This is exactly what has been done and, while the impetus of the defense job has made it possible to get new equipment for arsenals in quantities undreamed of by ordnance officers during the past 20 years, the arsenals remain a relatively minor production factor as compared to the defense-material output of private industry. They are, in fact, the experimental laboratories of the army.

The railroads, on the other hand, would find it rather difficult to fall back on private industry for the major part of the maintenance of motive power and rolling stock, because the plants that are equipped to do that kind of work in the necessary volume to meet rail transportation needs are insufficient in number to be any real factor.

The foregoing discussion is presented as background for exploring the possibilities of doing two things that have been suggested during recent months in several quarters, namely: that of using the "excess capacity" of railroad shops for defense production work or transferring a portion of the skilled mechanics in railroad shops to other industries where they may be more urgently needed.

Without going too deeply into the statistics of the maintenance of equipment it may help considerably to put a few figures into this record in the hope that an interpretation of them may assist in an understanding of this question. Back in February, 1937, there were 7,228 steam locomotives "in or awaiting shop." In February, 1938, there were 6,672; in February 1939, 8,459; in February 1940, 6,324 and in February 1941, 5,853. This figure has been steadily dropping month by month until on August 1 of this year there were only 4,022 locomotives in or awaiting shop. Since January 1940 locomotive mileage has been increasing, due to an increasing volume of traffic until in August,

1941, for freight locomotives, the increase over January, 1940 was 10 million miles a month.

We believe it is safe to assume that the great reduction in the number of locomotives in or awaiting shop in the 19 months ending August 1 is due, in large part at least, to the fact that the backlog of idle motive power in unserviceable condition that existed 19 months ago has now gone through the shop and is either ready for service or actually in service and that the 4,022 locomotives classified as in or awaiting shop on October 1, 1941, are largely actually in the shop undergoing repair work and that we have reached a stage where the locomotives now in service and due for repairs are kept in service until they can be taken into the shop.

Man hours for machinists engaged in locomotive repair work show a steady increase from about 7,300,000 in January, 1940, to 8,618,000 in July, 1941, with proportionate increases in overtime hours.

In view of these facts, which may be interpreted with considerable latitude depending upon individual viewpoint, it is rather difficult to understand just where the excess capacity or the excess manpower may exist at the present time in the average railroad shop. We have pointed out previously that if by excess capacity it is meant that there are idle machine tools or other shop facilities it is only reasonable to assume, from general observation that, where repair facilities are idle, it is either because they are too old to be of any real productive value or because it is impossible to get skilled mechanics to operate them. Such being the case, where is the excess capacity?

There is also another side to the picture that is well illustrated by a shop containing over 300 machine-tool units over 80 per cent of which are more than 10 years old. The machines that are less than 10 years old have mostly been installed in the past five or six years, and these newer machines are carrying the principal burden of the shop. When the pressure for more output became heavier these machines were first manned by second and third trick operators and then as forces were increased many of the older machines, some of which had not been used in 10 years, were placed in service. When this stage of the expansion program had been reached the wide difference in the productive capacity and the economy between the old and the new machine tools became instantly apparent.

The only conclusions that can be drawn from this discussion is that the railroad repair shops have just about all they can do to keep up with the present demand for motive power; that the necessity of falling back on older equipment has increased the cost of doing work; that if any excess capacity exists in a railroad shop it must be in the most obsolete facilities which are idle only because they cannot be used economically and, as far as man power is concerned, the railroads are faced with a shortage of skilled mechanics and are now centering attention on training programs. The railroads are vital to the defense program and they cannot be starved of needed equipment or men without crippling that program.

New Books

A Century of Reading Company Motive Power. *Published by Publicity Department, Reading Company, Philadelphia, Pa. Bound in heavy paper. 108 pages. Price, $1.25.*

From Baldwin's first product, "Old Ironsides," built for the later-absorbed Philadelphia, Germantown & Norristown in 1832 to the latest Diesel-electric switcher, the gamut of locomotives is covered by detailed treatment of representative types. For each there appears a large-size photograph, engraving or print and text-matter, giving specifications, origin, service, disposition, and pertinent anecdotes. In addition, there is contained a brief history of the road by J. V. Hare, secretary-treasurer, and a color insert showing the entire "Crusader" train.

The Reading is remarkable for the number and importance of developments in locomotive design for which it was responsible. It imported many unusual locomotives from Great Britain; purchased the first Baldwin product (which the toolmaker said would be his last locomotive); encouraged Ross Winans' experiments with "Camels" for heavy freight service; and brought out the Milholland locomotive for burning anthracite and the Wootten firebox for burning waste anthracite. More recently it pioneered in "face-lifting" the steam-locomotive by "semi-streamlining" its fast Pacifics.

General Engineering Handbook. *Editor-in-Chief, Charles Edward O'Rourke, Professor of Structural Engineering, Cornell University. Second Edition (1940). Published by the McGraw-Hill Book Company, Inc., 330 West 42nd St., New York. Leatherette Binding. 1,080 pages and index. Price, $4.*

This book was first published in 1932 under the direction of the present editor-in-chief and a large group of contributors. Its value lies not so much in the extent of the data contained in it applicable to any one specialized field of engineering as in the fact that within its covers will be found the important fundamental data relating to the several branches of engineering. Important revisions in the second edition are the omission of some of the more highly specialized sections of the first edition and the expansion of the material in some of the basic sections of the book. The scope of the book is indicated by a list of the sections, which are: Mathematics; Mathematical Tables; Physical Tables; Engineering Materials; Theoretical Mechanics; Hydraulics; Structural Theory and Design; Plain and Reinforced Concrete; Foundations; Topographic and Geodetic Surveying; Route Surveying and Earthwork; Highways; Municipal Sanitation; Machine Elements; Pumps; Compressors, and Hydraulic Turbines; Engineering Thermodynamics; Heating and Air Conditioning; Fundamentals of Electrical Engineering, and Electrical Measurements.

THE READER'S PAGE

Reduce Brake Charging Time

To the Editor:

Since the advent of the AB freight brake equipment we have listened to many discussions as to the necessary time required to charge a train fully consisting wholly or partly of AB brakes, and as to when it can be known positively that the brake system on each car is charged to a point where a terminal test of the brakes can be made. We hear of many different time requirements for charging an AB brake, all the way from 7 min. up to 15 min., and over.

The failure to know positively that the brake system is fully charged has, on many occasions, caused the setting out of cars because the brakes would not apply. I believe I have a suggestion to offer that would benefit everybody connected with this work. It is now the universal practice to attach the air gage in the way-car to the brake pipe and this is the only indication to the trainmen as to whether there is air in the train, but it does not reflect a true picture. The rule governing terminal tests says that when the gage pressure is raised to a point 5 lb. below the feed-valve pressure on the engine, a brake application may be called for. However, we know that the gage in the caboose can indicate this pressure long before that amount of pressure is in the auxiliary reservoir of the car.

My suggestion is that this gage connection be taken from the auxiliary reservoir on the way-car instead of the brake pipe. Then the gage will always indicate to what extent the brake system is charged. An additional feature which I believe would also be a big help to the trainmen would be to use a duplex air gage instead of the current single point gage. Connecting one hand to the auxiliary reservoir and the other hand to the brake cylinder, the trainmen would then know whether the caboose brake was fully released or not, with the reasonable assurance that if there was air in the brake cylinder on the caboose some of the brakes immediately ahead of the caboose would also be applied and the trainmen could then prevent the train from departing before all brakes were released.

T. H. Birch,
Air Brake Foreman,
C. M. St. P. & P.

Keeping the Record Straight

To the Editor:

The late Sir Nigel Gresley did not contribute the three-cylinder single-expansion locomotive to railway engineering, nor was he the first to patent the principle upon which all so-called conjugate valve gears for three-cylinder locomotives are based. These facts do not reflect upon his reputation as an engineer. The man who achieves conspicuous success in any field must possess a marked talent for adapting the ideas of others to his own requirements.

Panegyrists frequently credit the subject of their eulogies with accomplishments which he may never have claimed for himself during his lifetime. Speaking before the Institution of Mechanical Engineers in Newcastle-upon-Tyne on July 7, 1925, Sir Nigel Gresley said: "The recent development of three-cylinder simple engines in England is due principally to the initiative of Sir Vincent L. Raven on the North Eastern Railway. . . . Under his direction 212 three-cylinder simple engines were built for the N. E. R. from 1909 to 1922."

It might be added that there are barely 40 recorded examples of three-cylinder single-expansion locomotives throughout the world prior to 1909. More than 100 of Sir Vincent Raven's engines were in service for some years before the first Gresley design appeared.

The Gresley valve gear for three-cylinder engines has provoked interminable argument, not only having regard to the merit of the gear as a steam-distributing mechanism, but also with respect to the circumstances surrounding its origin. It should be clearly understood that all of the existing forms of conjugate valve gear for three-cylinder locomotives are founded upon the same mathematical principle. So far as the present writer has ever been able to find, the first enunciation of this principle is contained in British patent No. 14107, which was issued to David Joy on October 25, 1884. Mr. Joy's patent contemplated the application of several forms of conjugate valve gear to three-cylinder locomotives and marine engines.

Proposals and suggestions by others followed at intervals until the subject must have become common knowledge among engineers, but no practical application appears to have been made until the winter of 1912-13. The first three-cylinder locomotive having its inner valve actuated by a combination of the movements of the two outer valves was built by Henschel and Son for the Berlin Metropolitan Railway. This was a large experimental tank engine of the 2-8-2 type, weighing 222,700 lb. in working order. The first trials of the engine were run in February, 1913, and a full description of both the engine and the trials appeared in Zeitschrift des Vereines deutscher Ingenieure for 1913, page 702. The form of valve gear used on this engine was later applied to more than 2,000 European locomotives.

According to the inventor himself, Sir Nigel Gresley conceived and designed the valve gear which bears his name in 1915, and his first three-cylinder locomotive was completed in May, 1918. By that time there were more than 500 three-cylinder simple engines with conjugate valve gears at work in Germany.

Because of the extreme difficulty in maintaining a satisfactory steam distribution with any type of conjugate valve gear, German designers and locomotive builders returned to the use of three separate gears after 1921. The Gresley valve gear has not been regarded with favor on any English railway, except the London & North Eastern. That railway now has a new chief mechanical engineer. It will be interesting to observe whether he follows in the footsteps of his predecessor, or reverts to the practice of his former chief, Sir Vincent Raven, who said in 1925: "I used three sets of valve gear and if I went back to rail work today, I would do the same again."

Wm. T. Hoecker.

Western Maryland Hopper Cars for Cement Handling

In anticipation of a greatly augmented cement movement to meet the requirements of national defense, the Western Maryland has installed modern facilities for transferring bulk cement from cars to barges at Port Covington terminal, Baltimore, Md. To take care of future needs orders were placed for 40 additional 70-ton covered hopper cars, to supplement the existing fleet.

However, during the latter part of April this year, and without any previous warning, the Lehigh Portland Cement Company announced to W. M. officers that, on May 9, (less than two weeks from the date of the announcement) they would start shipping from their plant at Union Bridge, Md., on the W. M., a huge volume of bulk cement to Baltimore for transport to barges and subsequent movement to the Newport News Shipbuilding & Dry Dock Company, at Newport News, Va. The existing fleet of covered hoppers was already handling as much cement as possible and could take care of no more. The 40 new cement cars on order would not be delivered for some months. The challenge was met with a decision to convert 30 coal hoppers for the temporary handling of this cement.

The time available was strictly limited and expense had to be taken into consideration, since after completing the haul of this particular cement tonnage, the hoppers will be returned to their regular service. The safety appliance requirements of the A. A. R. had to be met, and the principal alterations were made for the purpose of keeping the lading dry under all kinds of weather conditions.

A tarpaulin cover was decided upon as the most practical covering for the car, supported by a roof of 1½ in. by 5 in. car siding, augmented by four pressed-steel carlines. Longitudinal and latitudinal running boards were placed on top of the tarpaulin and securely fastened to the roof. As shown in the illustrations, the tarpaulins are fastened with ropes to rings welded to the sides of the car at intervals, thus keeping the tarpaulin taut and in position to protect the lading completely, while at the same time, permitting easy removal of the covering when it becomes necessary to unload the cars.

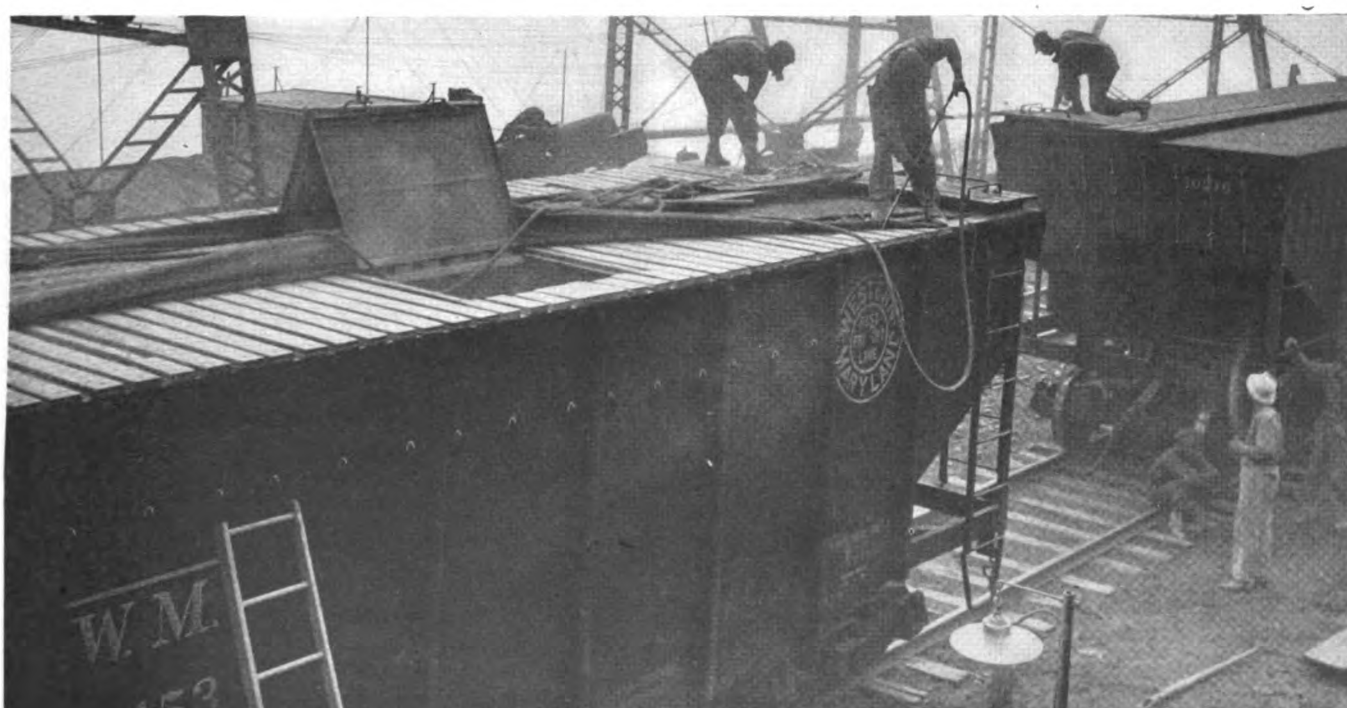
Before the converted cars were put in shuttle service between the cement plant at Union Bridge, Md., and the Port Covington pier transfer device, the insides of all the hoppers were completely sand-blasted and all scale removed, so that the cement would slide easily during unloading. The cars were also water-tested to discover any minute leaks that may have existed. The small sections that were not found watertight were closed by welding.

The W. M. shops put these cars through in record time and they were ready for the shuttle service a day or two ahead of the deadline. They have been in constant use ever since, giving excellent service. The cement company has reported no difficulty in loading or unloading and the cement has been arriving in perfect condition.

The roofs of these cars are made of 1½ in. by 5 in. car siding, spaced on 7 in. centers. These pieces are fastened to the car by ½ in. water-tight bolts through the bulb angles. In order to give additional stiffness to the roof and running boards, which must be well supported, four pressed steel carlines (on hand as scrap material), were substituted for the 12th and 24th roof boards from either end.. Wood fillers over the flat ends of these carlines assured a uniform edge, over which the tarpaulin could be drawn.

The cars are loaded through 30-in. by 48-in. hatchways. There are two of these on the transverse center line of the car, one on either side of the running board. The hatchways are covered by metal doors, made from scrap Hutchins car roof sections. The doors are hinged to open over the running board, and are 34 in. by 50 in. and close against the flange of the two inside steel carlines on two sides, and against wooden battens bolted across the under side of the roof boards on the other two sides. The roof boards themselves are cut back to clear two handles riveted to the outside edge of each door.

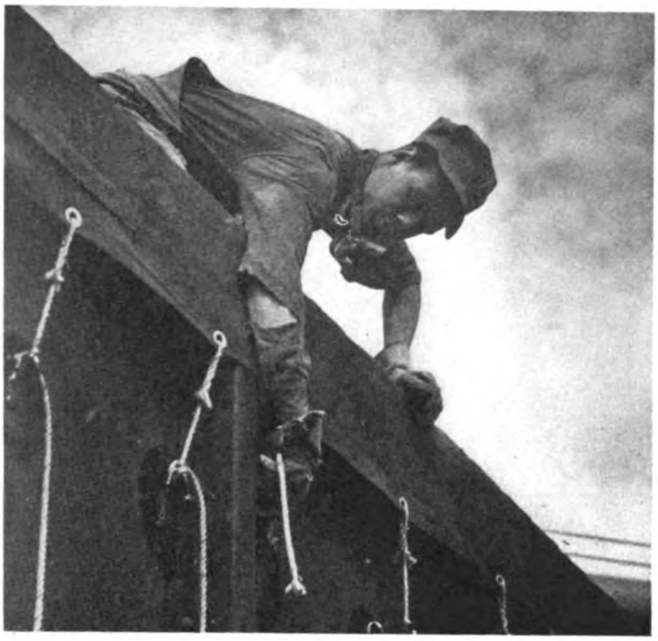
The tarpaulin is made of No. 6 water-proof canvas,



The converted open-top hopper cars as reconstructed to permit handling bulk cement

and turns down 12 in. on the sides and "A" end, and 8 in. on the "B" end to clear the hand brake. All corners are strongly reinforced. Ropes 3 ft. in length are used to tie down the tarpaulin to a series of special rope locks, which are welded to the car. Tie ropes are secured to the tarpaulin through grommets, spaced to suit rope locks. The tarpaulins and rope locks were furnished by the F. M. Stevenson Company, Baltimore, Md., made especially for use on these cars.

The longitudinal running board is made of 1⅛ in. by 6 in. wood and carried by 10 saddles of 3-in. by 3-in. by 19-in. wood. The latitudinal running boards are of the same dimensions and carried by three 3-in. by 3-in. by 26-in. wood saddles. Milar car cement is used under



Attaching tarpaulin ropes to the rings on a car side

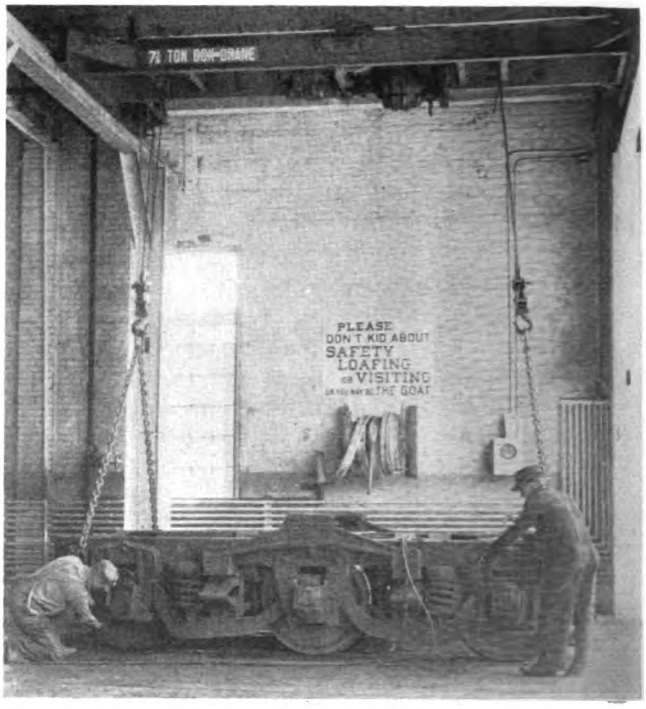
the saddles as a water-proofing agent. In order to meet the I. C. C. safety requirements, side and end ladder treads were changed to suit a covered hopper car, and additional grab irons placed on the running boards for safety.

The hoppers are equipped with Wine cast-steel hopper frames, doors and locks, which afford a tight joint to begin with, but in order to be assured of this feature, a 2-in. strip of Armstrong Cork Company's Rk-304 cork and rubber gasket with adhesive base is placed around the hopper edges. This provides a tight door and seals it against possible loss of cement.

Two Passenger Car Shop Devices

In order to save labor in handling passenger truck repairs, the Burnham coach shop of the Denver & Rio Grande Western is equipped with a 7½-ton traveling box crane at each end and at the center of the shop. The shop is slightly more than long enough to accommodate two conventional passenger cars on each track, so the trucks may be run out from each end of each car and the wheels changed, also bolsters, equalizers, or springs, and brake work done without any manual lifting or jacking of the truck frame.

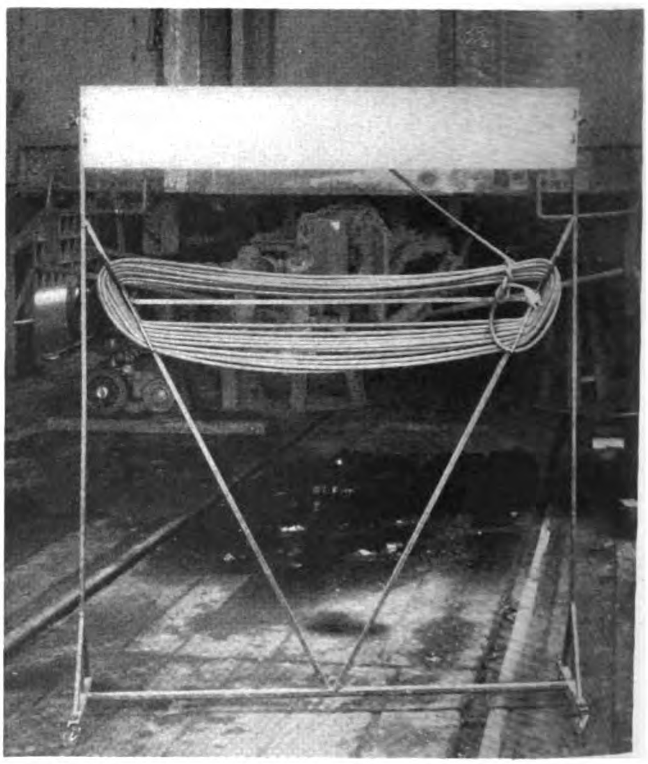
The crane consists of two 12-in. channels with cross



A 7½-ton box crane with electric-operated hoist for truck repair work

members and diagonal braces welded in place. It is designed to operate on four wheels which traverse light rails extending crosswise of the coach shop tracks. The electric motor operates cables which lift both ends of the truck simultaneously under push button control. The crane is traversed crosswise of the shop by hand so it may be readily located over any track.

A portable fluorescent light stand effectively lights the inside of the cars being repaired or painted. The stand consists of a 1-in. channel iron framework, 54 in. long by 60 in. high. Casters on the bottom facilitate easy

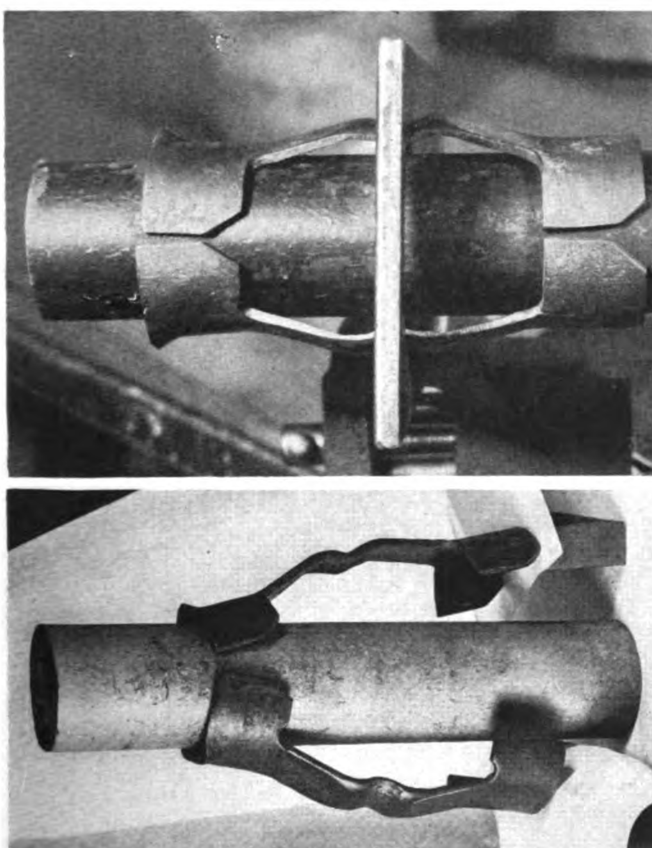


Portable fluorescent light stand for lighting coach interiors

movement about the shop. The light trough is made of welded No. 12 gage iron, 5 in. wide at the bottom and having a flaring top 8 in. wide. A transformer is built into the base of this lighting trough, the interior of which is painted with white enamel to give good reflecting properties. Either end of the trough is equipped to support two 4-kw. fluorescent light bulbs. About 100 ft. of cord are available so that the fluorescent light stand may be placed wherever desired inside the car.

Flexible Pipe Clamp

The Baker clamp, now being introduced by the Du-Wel Steel Products Company, Chicago, utilizes a new principle in air brake pipe clamping which is said to give a firm, continuous grip on the pipe and yet afford sufficient flexibility so that the pipe is permitted to assume its natural position, without initial stress on pipe joints or



Du-Wel Baker clamp designed to hold air-brake pipe firmly but without rigid connection to the car frame

fittings, and with vibration largely absorbed in the clamps instead of being transmitted to the steel frame of the car.

The new Baker clamps are made of two sections of specification spheroidized annealed spring steel, tempered to the exact degree of Rockwell hardness found desirable by extensive laboratory tests and service experience. As shown in the illustration, these clamps snap in place with a few hammer blows and can be easily driven out for re-use as many times as may be desired. With this type of clamping device, it is said that there can be no "over-clamping" and that all stress or strain on pipes having a tendency to cause leaky joints and pipe breakage are eliminated.

Air Brake Questions and Answers

AB-8, Empty and Load Equipment (Continued)

23—*Q.—How does the strut cylinder volume function?* A.—This volume with choke *103* in the pipe bracket (shown in Fig. 5) operates to control the air supply to the change-over valve. This is set up to furnish sufficient time for the change-over valve to assume its proper position at the time an uncharged air is connected to a charge brake pipe. During an emergency application it seems to prevent the change-over valve from operating.

24—*Q.—What is the purpose of the cut-off valve portion?* A.—The change-over operation at such a time as the brake pipe on the cars is being recharged is required. This would occur on picking up a car after having been set out for any reason.

25—*Q.—Of what parts does this portion exist?* A.—Referring to Fig. 6, it has a piston (*66*) with slide valve (*67*) attached, diaphragm (*72*) and spring (*76*).

26—*Q.—What is the value of the spring?* A.—30 lb.

27—*Q.—When the brake pipe pressure is reduced below 30 lb., what happens?* A.—As the spring valve is 30 lb., the piston and slide valve moves downward so that the port from the brake pipe to the strut cylinder and change-over portion is opened by the slide valve. Air is supplied to these portions for change-over operation on a subsequent recharge of brake pipe.

28—*Q.—When do the piston and slide valve assume their upper position again?* A.—When the brake pipe pressure is restored to above 30 lb., the piston and slide valve assume their upper position, where the supply to the change-over portion is cut off.

29—*Q.—Describe the parts of this portion.* A.—Large change-over piston *4* with slide valve attached (Fig. 6) and small change over piston *16* fitted to the stem of the former. Latch piston *20* (Fig. 5) lever and latch *26* and *27*, slide valve strut *10* (Fig. 6) diaphragm and spring *11* and *13*.

30—*Q.—How many positions has the large change-over piston, and when is the latch piston in operation?* A.—The large change-over piston has two positions empty (down) and load position (up). The latch piston is operated only during the change-over period, air from the brake pipe via cut-off portion forcing it upward. This caused lever *26* to withdraw latch *27* from engagement with the change-over piston, and the piston assumes its proper position.

31—*Q.—What happens after the change over is effected?* A.—The latch springs *24* and *25* return the latch to its lower position, where the latch holds the change-over piston in its proper position.

32—*Q.—What is the function of the slide valve strut?* A.—It holds the slide valve to its seat by reason of the pressure exerted on the diaphragm by brake cylinder air.

33—*Q.—What flow of air does the transfer valve portion control in load position of the change-over portion and during release?* A.—To the brake cylinder in load position, permitting the empty cylinder to apply in order to take up the brake rigging slack previous to the application of the load cylinder. In release pressure from the load cylinder ahead of pressure from the empty cylinder to prevent strain on the load cylinder mechanism.

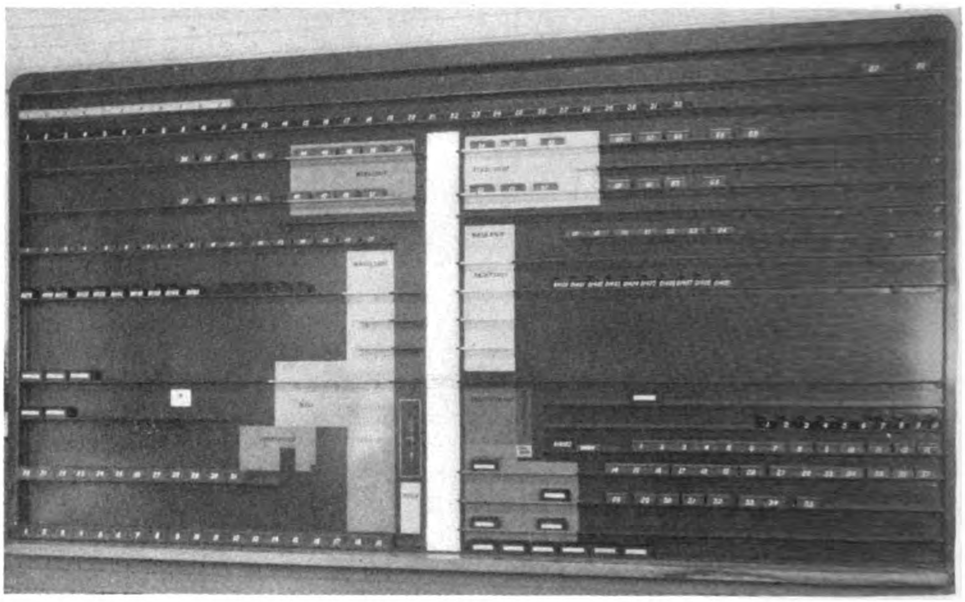
34—*Q.—Referring to Section AA, (Fig. 5), what are the operating parts?* A.—Two valves, release check *51*, and empty cylinder check *47*, with their springs and the transfer piston *41* with its spring.

Car Progress Board At Burnham Shops

One important feature of the Burnham car shops of the Denver & Rio Grande Western, Denver, Colo., is the car Progress Board, illustrated. This progress board, made of galvanized iron, about 7 ft. long by 4 ft. wide, is mounted on the office wall opposite the foreman's desk and shows at a glance not only the location of all car shop buildings, repair tracks, etc., but also indicates the location of all cars which are undergoing or awaiting repairs here.

The progress board is flanged on the outside 1 in., with welded corners and having 1-in. horizontal strips flanged and riveted in place at all track locations, both inside and outside of the shop buildings. The location of the transfer table is plainly indicated, also the various shop buildings, which are shown with different colored paints. The different series of cars repaired at Burnham shops are represented by small wood blocks which indicate either by their shape or color the type of car referred to. For example, the block representing a box car is painted red and has roughly the proportions of a box car, being a little higher for an automobile car than for a common box car. Flat-car and caboose-car blocks have the distinctive shapes indicated and are painted black. Outfit cars, on the other hand, are painted gray. It is the duty of the foreman to change the position of these car blocks after each day's work and thereby reflect the progress of the cars through the shops and the location of all cars on the outside tracks at any time, rendering it possible for the superior officer, at a glance, to observe the status of deferred or shop program.

The outer office, adjacent to that of the general car foreman at Burnham shops, is well lighted and is equipped with four desks for the use of department foremen and supervisors.



General car foreman's Progress Board for indicating car positions at the Burnham shops of the D. & R. G. W.

Four-position desk arrangement in the car supervisor's office

Questions and Answers On Welding Practices

(The material in this department is for the assistance of those who are interested in, or wish help on problems relating to welding practices as applied to locomotive and car maintenance. The department is open to any person who cares to submit problems for solution. All communications should bear the name and address of the writer, whose identity will not be disclosed when request is made to that effect.)

Keeping Babbitt On Valve-Rod Crossheads

Q. We have encountered trouble keeping babbitt on valve rod crossheads. The metal breaks off in large pieces necessitating frequent rebabbitting. Can you suggest a method of holding this babbitt in place?

A.—There seems to be no positive way of holding babbitt in place. Some roads apply wear-resisting bronze in place of the babbitt. A heavy layer of bronze is applied to the three sides of the crosshead and machined to size. While this operation requires more time than the babbitt method, the subsequent wear is well worth the extra expense.

Welding From One Side Of A Locomotive Frame

Q.—Several times recently it has fallen to my lot to have to vee a locomotive frame so located that all cutting had to be done from one side. At times this was made more difficult by a casting on the back so that it could not be cut through. Is there an easy way of doing this difficult job?

A.—Use a piercing nozzle instead of a cutting nozzle. The piercing nozzle is swung from side to side making a cut about two inches wide about five-sixths of the way through the frame. The regular nozzle is then put back in the torch and the remainder of the frame cut and the V made to suit the operator.

The First Bead In A Vertical Vee

Q.—I have a great deal of trouble with the first bead in a vertical vee when using heavy coated rod. How can the difficulty be overcome?

A.—Experienced welders often have the same difficulty with the first bead in a vertical vee when using coated rod. Although there are those who discourage the use of a down-hill first bead, it has been accepted by many welders as the best way of overcoming the practice of filling the vee with "bunches of grapes" and the usual laps and slag inclusions. When running a down-hill bead be sure and use heat (amperage) enough to secure sufficient penetration.

Changing The Tone Of Chime Whistles

Q.—Many locomotive whistles are of the five-tone chime type and are very shrill. There has been a great deal of complaint about these whistles and we are desirous of finding a way to deepen the tone of those used on locomotives operating in the territory where the most complaints are made.

A.—In order to deepen the tone, the short steps on the whistle must be eliminated. Melt or cut the top from the two short steps. If the casting is bronze, chip or file all sand and dirt from the parts that will need welding. The next step is to shape some ⅛-in. plate into pieces that will have the same radius as the whistle and reach from the top of the short steps to the top of the casting. Two narrow strips will be needed to continue the ribs to the top. The pieces are now ready for brazing. The casting is preheated, the pieces held in place and brazed securely. A small curved section is made for the top and this brazed in place.

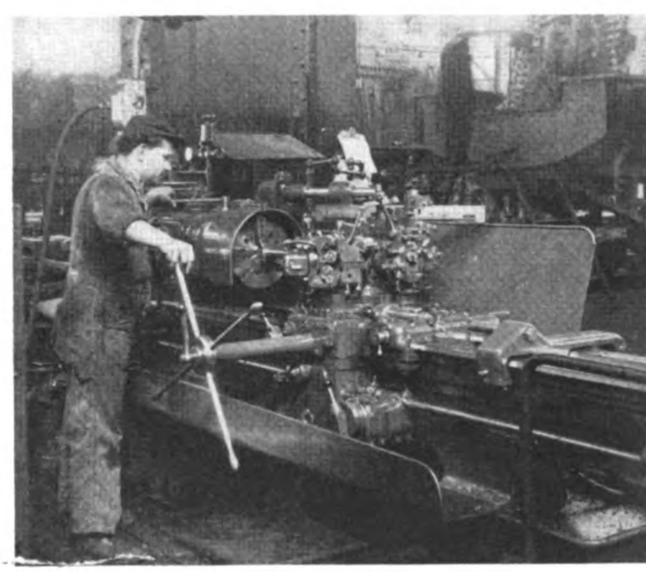
Cutting Through Layers of Rust

Q.—Is there any way of solving the rust problem when cutting scrap, especially on parts such as bolsters, where the operator must cut through two or more thicknesses of metal with a layer of rust between each one?

A.—Instead of attempting to cut through the numerous layers, hold the torch parallel with the work and cut one layer at a time. Through the kerf formed by this cut, clean the rust from the next layer with a hammer and chisel and proceed in the same manner. This works equally well on scrap boilers where there is a heavy scale on the inside.

High Production Turret Lathe

The Jones & Lamson 2½-in. by 40-in. turret lathe illustrated is a high-production tool recently installed in a large western railroad shop and used exclusively for machining and fitting engine frame bolts having a taper of $\frac{1}{16}$ in. in 12 in. The hex heads of these forged bolts are gripped in the air-operated three-jaw chuck and the

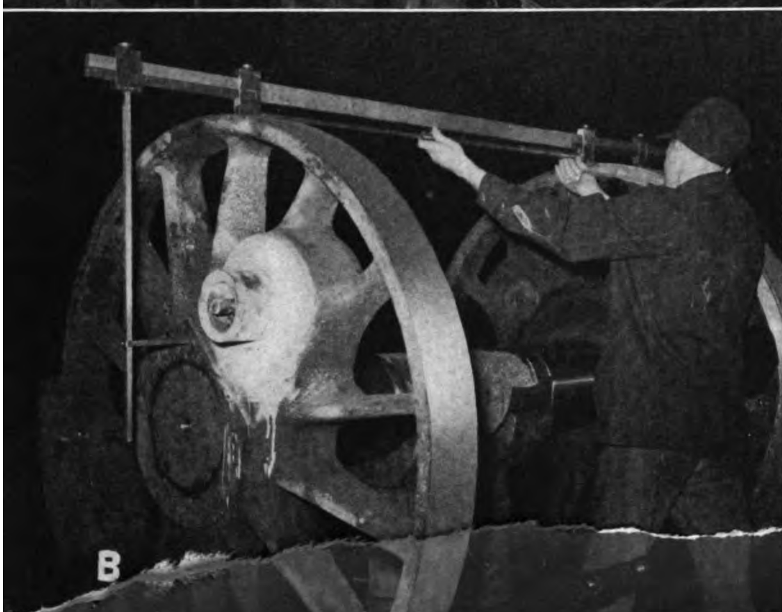


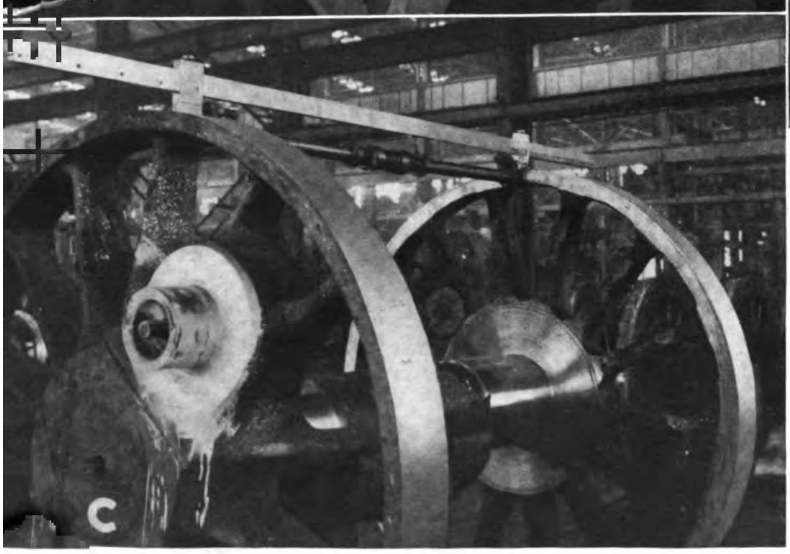
Turret lathe tooled for the rapid production of locomotive frame bolts

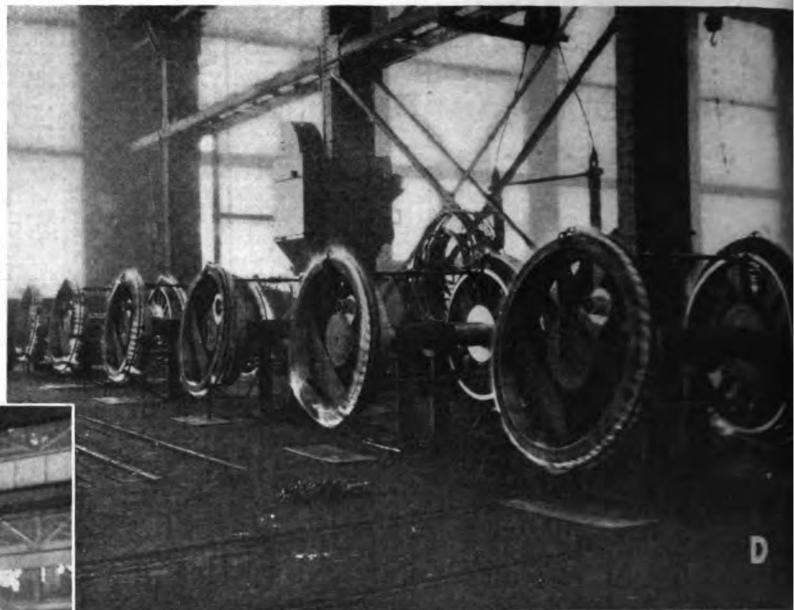
frame bolt fitted and threaded in one set-up on the machine using five operations—(1) pointing, (2) cutting for thread size, (3) cutting for length, (4) tapering for size, and (5) threading, using a special die head.

Where only a few bolts are required, the operator takes the bolt size at the locomotive, but with a fixed size these bolts can be machined from floor to floor in 4 min. each. Saddle bolts, 1½-in. by 6-in., require only 2½ min. each. Individual bolts, when cut from 1½-in. by 18½-in. rough stock, are machined to 1¼-in. in one cut taking about 15 min. The machine is used on two shifts in order to maintain the production for this shop. Large modern locomotives, even with cast-steel bed frames, frequently require as many as 78 bolts to be fitted for each locomotive.

SETTING TIRES







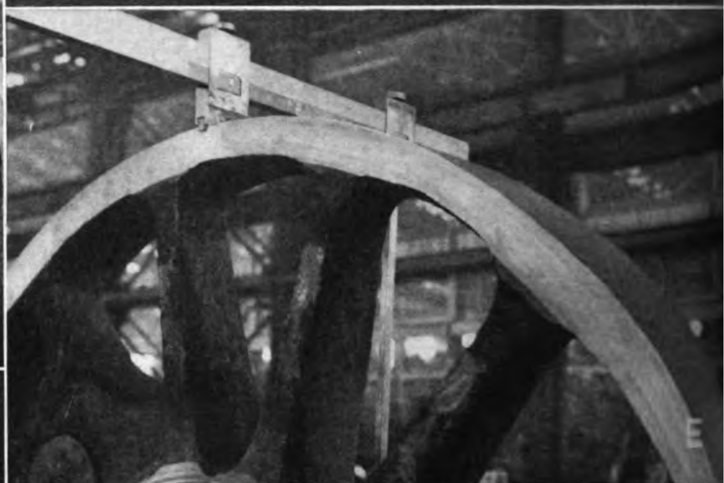


Fig. 1—(A) The tram gage is set across a pair of wheel centers and the gage is centered by means of the scales when the pointers are against the outside wheel hubs; (B) The runners on the tram gage are set with the inside micrometer shown in Fig. 4; (C) After the runners on the tram gage are properly set the spreaders are set between the wheel center rims; (D) A set of wheel centers for an articulated locomotive on the stands with the gas tire heaters in operation—the gas flame, when properly adjusted as to air proportions, is blue but in this case the amount of air was cut down to produce a flame that would show in the photograph; (E) The sliding contact point on the runner; (F) The heated tire is pushed onto the center

At the Huntington, W. Va., shops of the Chesapeake & Ohio, several advanced ideas have been developed in connection with the machining and assembly of the parts of locomotive running gear all leading to the ultimate erection of the wheels, bearing and frame assembly in absolute alignment when the locomotive leaves the shop after general repairs. An interesting phase of this work is the setting of driving tires on wheel centers and this article is concerned primarily with that job.

In the development of improved shop methods in connection with tire setting, several devices designed to facilitate the work and effect economies have been installed. Among these are a full set of mounted-wheel stands to accommodate six pairs of wheels, a full complement of gas-fired ring heaters, spreader gages, micrometers and spring clamps. These will be described in connection with their use.

The illustrations in Fig. 1 show the type and construction of the wheel stands of which there are two supporting each axle. The wheel centers on which tires are to be mounted are set on these stands.

In setting tires three sets of gages are used: an inside micrometer shown in Fig. 4 used for checking the distance between wheel hubs and for setting the runners (*6*) on the tram gage shown in Fig. 1; a gage, shown in Figs. 3 and 5, for checking the distance from the tire flange to the wheel hubs; and the spreader gages which are placed between the rims of the wheel centers—three to a wheel pair, 120 deg. apart.

The construction of the inside micrometer is clearly shown in Fig. 4. The tram gage and the manner in which it is used is shown in Fig. 5. The tram gage consists of an 84-in. bar (*2*) with scales 16 in. long one at each end of the bar. These two scales are divided in inches and sixteenths and each reads from zero at the inner end to 16 at the outer end. The inner ends, or zero points, are 53 in. apart. Since 71 in. is the maximum axle length, and 8 in. is the maximum hub thickness (*B*) the 16-in. scales are sufficient for all requirements.

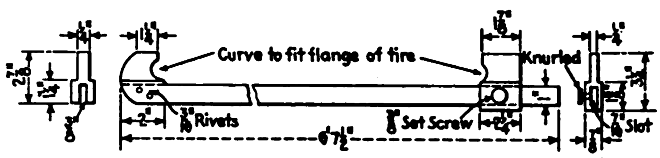


Fig. 2.—Tire and hub gage

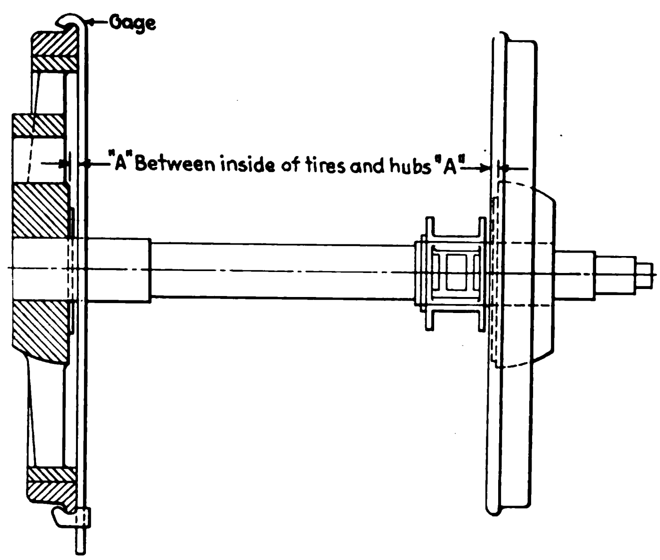


Fig. 3.—Application of the tire and hub gage

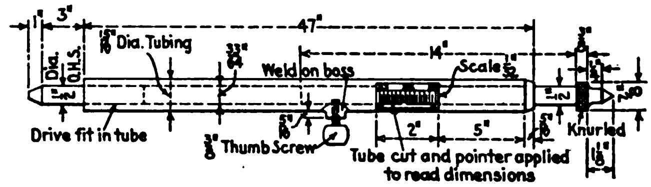


Fig. 4.—Inside micrometer for setting spreader gages

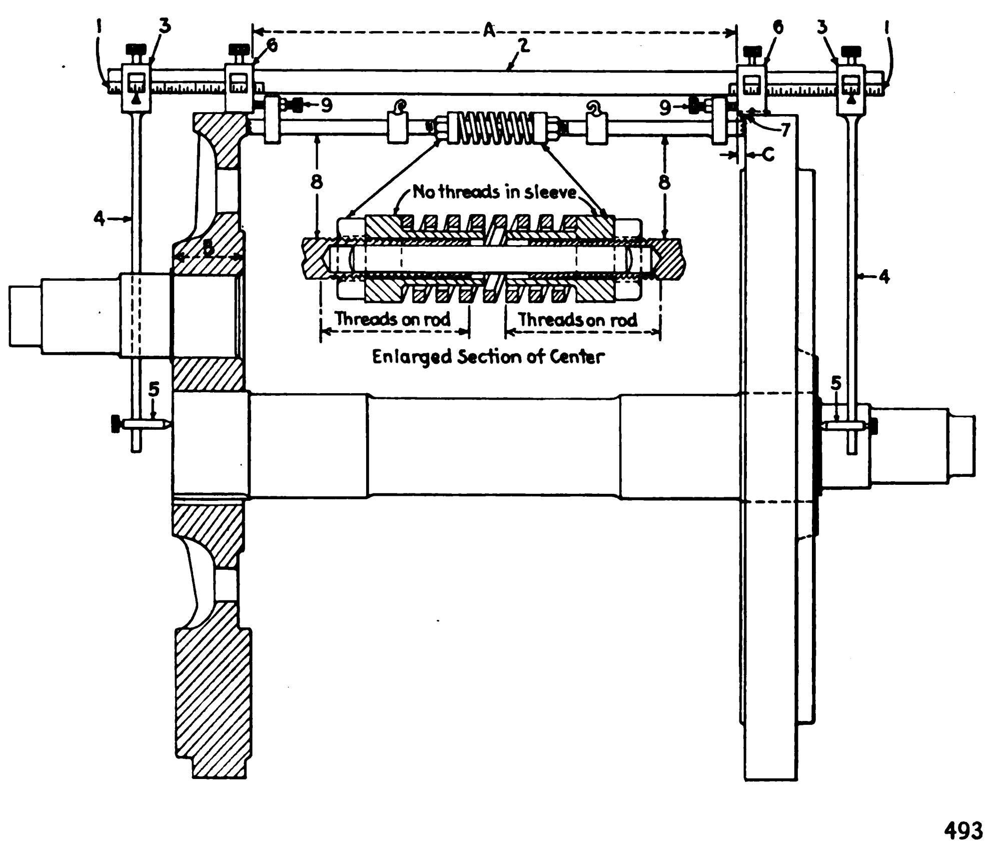


Fig. 5.—The use of the tram gage on a pair of wheel centers is shown in this drawing together with a section of the spreader gage and its application to the wheels

In using the tram gage it is placed across a pair of wheel centers, as shown in Fig 5, after the runners (*6*) have been set with the inside micrometer at the distance to which the tires are to be set. The gage is centered by adjusting the runners (*3*) so that identical readings appear on both scales (*1*) when the pointers (*5*) are against the outside of the wheel hubs. The tire setting dimension (*A*) having been set with the inside micrometer the runners (*6*) are locked in position on the bar (*2*) and the spreader gages (*8*) are put in position ready to be set.

The construction of the spreader gages is shown in Figs. 1 and 5. Each gage consists of two hollow rods, each threaded at one end and with knurled solid ends at the other. At the solid end there is a fixed bracket integral with the hollow rod. In this bracket is threaded a gaging screw (*9*) on which is a lock nut. These two hollow rods slide over a solid rod and at the center of this assembly is a heavy spring with two seats or collars which slip over the threaded ends of the hollow rods. On the threads of these hollow rods are adjusting nuts.

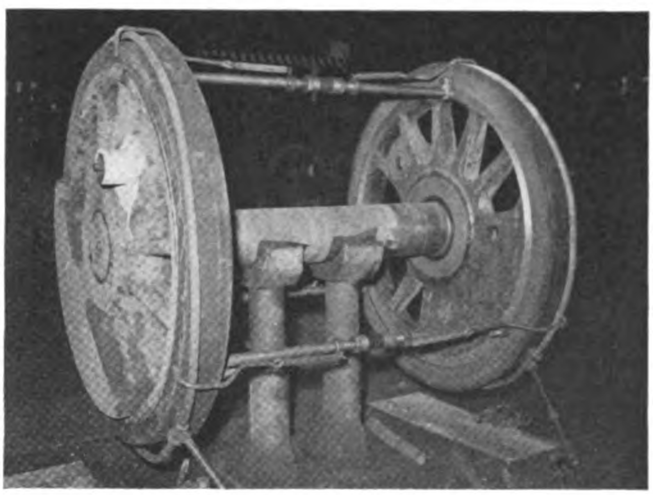


Fig. 6.—The spring clamps for holding the heated tires while they are cooling. The axle stands are also shown in this photograph

Two welded collars with hooks for the clamp springs complete the assembly of the spreader gage. There are 18 of these gages in a complete set.

In use, the knurled ends of a spreader are placed against the inside of the two wheel-center rims and the adjusting nuts are moved toward the center spring, thereby increasing the tension on the spring and the pressure of the knurled ends against the wheel centers. This spring arrangement provides automatic compensation in the spreader for any pulling-in of the wheel centers as the tires are cooling and simplifies the job of removing the spreaders. The distance over the two gaging screws in the brackets of each spreader is set with the tram gage. The tram gage is first set with an inside micrometer to the desired distance between tires. After the distance from the hub to the inside of the wheel center rim is measured with the gage shown in Fig. 2 on both wheel centers and the amount of adjustment (*C*) in Fig. 5 determined, there is a sliding contact point (*7*) on one runner (*6*) of the tram gage that rests against the inside of the machined wheel-center rim and definitely locates the gage and ultimately the tire setting with relation to the wheel centers. This distance, when set, represents the distance between tires on the mounted wheels.

When the spreaders have been set on all wheels the tires are placed on the wheel centers and the gas heaters set up and lighted. A blue chalk mark on each tire is used as an indicator for proper setting heat, this mark changing to yellow at about 350 deg. F. and to white at about 400 deg. F. At this temperature, a tire for a 50-in. center which has been bored .059 in.* smaller than the outside diameter of the wheel center will have expanded to approximately .125 in. larger than the wheel center so that it is quite free to slip over the center.

The hot tires are now pushed onto the centers and up against the gaging screws of the three spreaders. Spring clamps are then hooked over the tires, as shown in Fig. 6, to hold the tires in position while cooling.

This method of setting tires has eliminated the necessity of returning mounted wheels from the wheel lathe to have the tires reset when they are found to have excessive "run-out" and cannot be machined without resetting.

The table shows the degree of accuracy to which tires may be set by this method.

Measurements Between Tires on Two Driving Wheel Sets

	Wheel Set No. 1		Wheel Set No. 2	
Point at which gaged	Hot, in.	Cold, in.	Hot, in.	Cold, in.
Top	53.345	53.326	53.260	53.245
90 deg.	53.330	53.305	53.265	53.254
Bottom	53.350	53.325	53.270	53.260
270 deg.	53.345	53.325	53.275	53.260
Nominal setting	53.375		53.250	

* This difference for other diameter wheel centers is as follows: 44-in. diameter, .050 in.; 56-in. diameter, .069 in.; 62-in. diameter, .079 in.; and 66-in. diameter, .086 in.

Locomotive Boiler Questions and Answers

By George M. Davies

(This department is for the help of those who desire assistance on locomotive boiler problems. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless special permission is given to do so. Our readers in the boiler shop are invited to submit their problems for solution.)

Steam-Shovel Boiler Repairs

Q.—I am a boilermaker employed by a mining company and thought perhaps you could give me some suggestions on repairing one of our steam-shovel boilers. The inner and outer door sheets are flanged towards each other and riveted. The rivets and the sheets are badly worn and must be repaired.—C. J.

A.—From the explanation given in the question, I assume that the repair to be made is to the fire-door hole. Repairs to fire-door holes can be made by welding. The inner and outer door sheets are supported by staybolts and for this reason the strength of the structure is not dependent upon the strength of the weld. The magnitude of the repairs to be made would depend entirely upon the condition of the sheets forming the fire-door hole.

Fig. 1 illustrates a method of repair when the rivets and seam are worn and leaking, the inner and outer door sheets otherwise in good condition. This repair consists of removing the rivets and plug welding the rivet holes, and seal welding the seam.

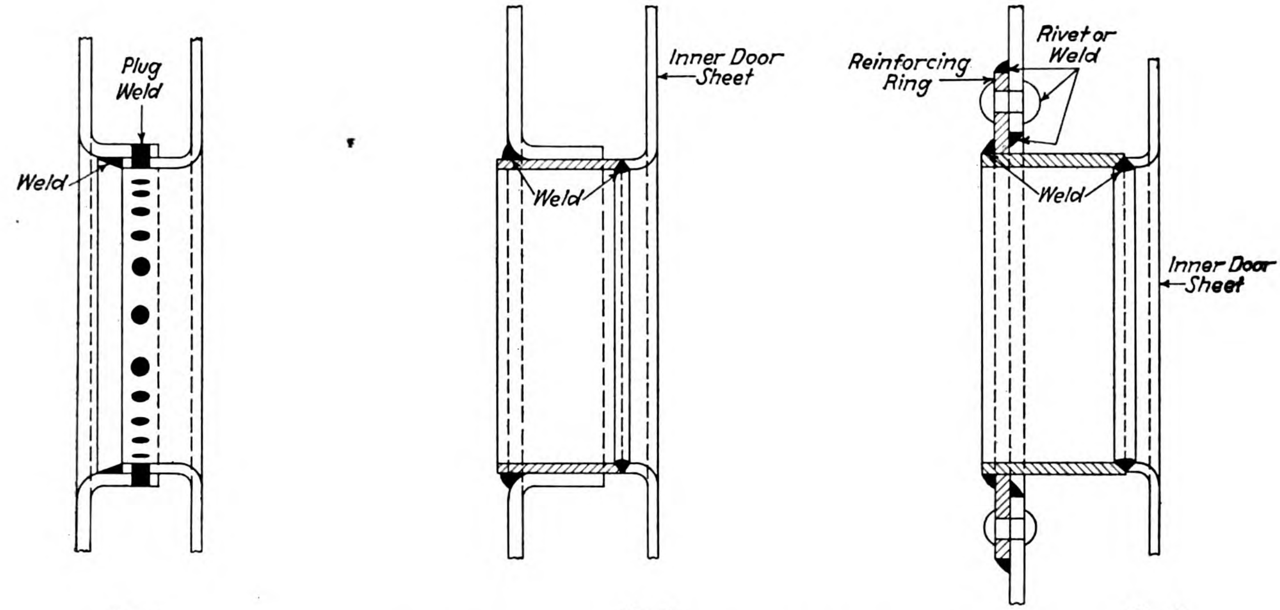


Fig. 1 Fig. 2 Fig. 3

Three methods of repairing the firedoor hole of a steam-shovel boiler

Fig. 2 illustrates a method of repair where the sheets forming the fire-door hole are badly worn in the hole and the seam itself is in a bad condition. This repair consists of removing the rivets and cutting out the inner door sheet of the fire-door hole at the knuckle; a new fire-door hole sheet is formed to the contour of the correct contour and butt welded on the top center line; the new ring is then inserted and butt welded to the inner door sheet and secured to the outer door sheet by a fillet weld.

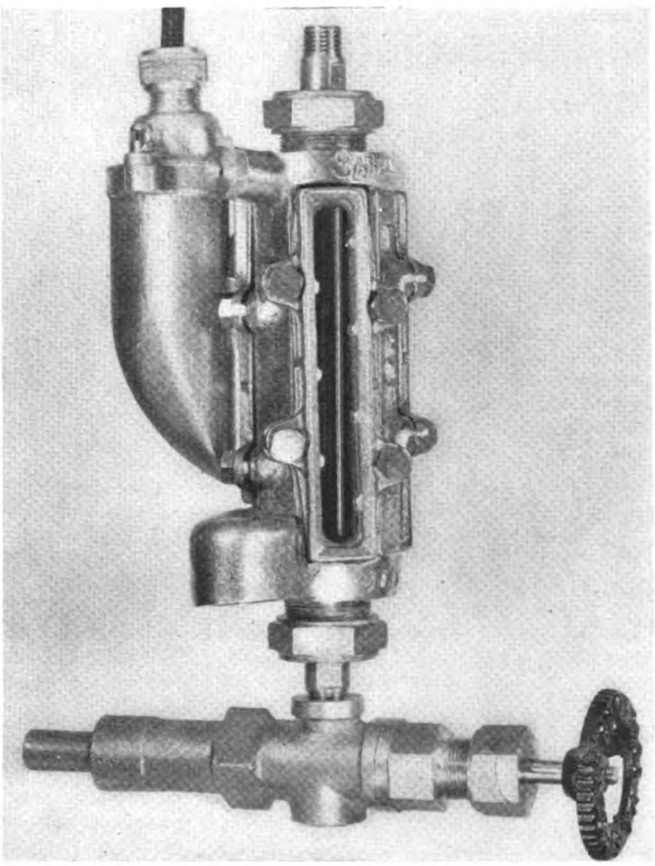
Fig. 3 illustrates a method of repair where the sheets in the fire door hole and the knuckle of the outer door sheet need renewing. This repair consists of cutting out the outer and inner door sheets, and applying a new fire-door-hole sheet, as in Fig. 2; in addition, a ring is riveted or welded on the outside of the outer door sheet to support the fire-door-hole ring. The fire-door-hole sheet is welded to the ring on the outer sheet as shown in Fig. 3.

All welds and repairs should be made to conform to the requirements of the A. S. M. E. code and before proceeding with the repairs approval should be obtained from the State Inspector under whose jurisdiction the boiler comes.

Protector for Tubular Water Glass

An improved locomotive tubular waterglass protector manufactured by the Sargent Company, Chicago, includes features giving added protection against personal injuries and simplifying the renewal, cleaning and replacement of the glass panels in the body without removing the protector or disturbing its steam connections. The tubular glass is inserted in the protector before the unit is attached to the water-glass cocks. It has an ample escape passage at the base, threaded for a pipe connection, to divert escaping steam, water and tubular glass fragments below the cab deck in the event of a bursted tubular glass under pressure. However, if this passage becomes clogged from any cause, the entire structure will withstand pressure and prevent the release of any damaging elements within the cab.

A ball check at the top, normally open, permits air circulation within the protector to prevent misty glass panels, but closes automatically at the slightest accumulation of internal pressure. A small brass tube integral with the fittings enters each end of the tubular glass to prevent the gasket from fouling the glass ends and producing a false water-level reading. The detachable bayonet-type lamp with insulated electric connections and socket illuminates the water level at all times but no light rays escape to interfere with the crew's vision.



The glass panels in the Sargent tubular water-glass protector can be cleaned and replaced without disturbing the steam connections

High Spots in
Railway Affairs . . .

Holiday Travel Of Soldiers

It looks as if there would be a record-breaking amount of passenger travel during the holiday season. There are now about 1,600,000 men in camps, as compared with about 500,000 a year ago. A new War Department regulation provides that following the maneuvers or similar specialized training periods, and during the Christmas holidays, up to 50 per cent of the individuals in an organization may be given furloughs at one time. Previous regulations restricted this to 15 per cent. Ralph Budd, defense transportation commissioner, has indicated that during the Christmas holidays service men on furlough will get the first call on transportation facilities.

Transportation Study Board

The Board of Investigation and Research, which was created by the Transportation Act of 1940, has apparently finally got started on its task. It is scheduled to make its final report by September, 1942. C. E. Childe, a member of the board, in a recent address outlined its attitude and job in the following words: "We are going to try to divest our minds of all preconceived opinions and prejudices, and, first, be a sponge for collecting all the available facts about transportation from every possible source; second, put these together in a form that will be informative to anyone who wants to study them; third, possibly we can then reach conclusions and make recommendations which will be valuable." The carriers are being called upon for a vast amount of information. They not only want this, but also in the words of Mr. Childe, "we want your advice and your best judgment on the broad question of how to develop a national transportation system which will best serve our national welfare."

Ice Cream for Soldiers

One example of unusual services required of the railroads by the troops on their maneuvers is the ice cream movement between Baltimore, Md., and Hamlet, N. C., a distance of 404 miles. To begin with, there was no tariff in existence to cover such a movement and it was necessary to quote special rates and receive the approval of the Interstate Commerce Commission. On September 28 the first of these movements included a train of 38 refrigerator cars. This is believed to be the first railroad shipment of ice cream in carload lots and probably the longest haul of this product in any quantity. In addition to the ice and salt in the bunkers, dry ice is packed between the cartons. At Hamlet, N. C., the ice cream is transferred to trucks and carried to destination in the field. Two or three deliveries are made at Hamlet each week and it is expected that this movement of ice cream will keep up until the maneuvers are completed. The shipments are routed over the B. & O., R. F. & P. and the Seaboard Air Line.

Guard Against Fire Losses

Few improvements in railroad operation over the years have been more spectacular than the reduction in losses by fire. In 1940 these totaled $3,557,764, or only about one-third of what they were in the year 1920, when they reached the peak. The 1940 record also shows a reduction of 16.3 per cent as compared to 1939. The average loss per mile of line in 1940 was $12.96, in 1939 $16.32 and in 1920 $54.40. These improvements are due largely to the persistent activity of the Fire Protection and Insurance Section of the A. A. R., and its predecessor organization, the Railway Fire Protection Association. A determined effort has been made by the railroads to locate the cause of every fire and then, with these facts established, to remove or reduce similar hazards wherever possible. Of the known causes of fires in 1940, those caused by trespassers on railroad property ranked first, and those caused by careless smokers who tossed away lighted matches, cigarettes and cigars ranked second.

Wage Negotiations

The hearings before the Emergency Board followed fairly closely the schedule set up in advance. Some unexpected developments, however, did occur. The carriers at one stage in the game submitted a plan for emergency compensation, which took into account the cost of living and revenues and would be in effect from November 1, 1941, to December 31, 1942. The labor leaders turned their thumbs down on this proposal. On October 18 the chairman of the Emergency Board suggested that the parties agree to arbitrate. The railways were willing to do this, but the labor leaders declined this proposal also. On October 21, board member Joseph H. Willets found it necessary to withdraw for several days, because of the death of his son. The hearing concluded on October 22 and the board started its deliberations. The board, with the concurrence of labor and the carriers, secured from the President a five-day extension of time for the preparation of the report. It will be presented to the President on November 5.

Spreading Information About Defense Contracts

How can a small manufacturer secure national defense contracts or know whether his plant is capable of doing such work for the government? In spite of all of the efforts that have been made to get such facts over to the smaller manufacturing concerns, it seems that something more intimate must be done by way of carrying this information in a more or less dramatic way to the four corners of the country. On November 10 three special trains, painted red, white and blue, will start from Washington. Each train of six cars will be equipped with samples of work to be done and other exhibits and conference tables. Two cars of each train will be used as living quarters for representatives of the Army, Navy, Maritime Commission and the Office of Production Management. These trains will not be open to the public, but manufacturers who are interested will have an opportunity of sitting down with the experts, first to find whether their equipment is such as to be capable of producing the necessary products, and then in advising those who have the right sort of equipment how to proceed in securing contracts. Interested manufacturers should contact with the nearest field office of the O. P. M. Contract Distribution Division.

Scrap Situation Serious

Our nation has been quite prodigal in shipping scrap abroad in recent years. With the great speeding up of production for war and national defense purposes, we now find ourselves in a rather serious predicament because of the shortage of scrap. The Office for Emergency Management has requested the railroads to check their entire systems in order to make available quickly all possible scrap. It emphasizes the following specific suggestions: "(1) Remove railroad sidings, branch lines and industrial tracks where they are not actually needed for present or prospective business. Appropriate action by public bodies is requested to facilitate this program. (2) Check equipment and dismantle promptly cars and locomotives that are not to be repaired. (3) Check miscellaneous facilities such as junk tools, bridges and buildings and dismantle those no longer needed to the extent necessary to make available all metal for scrap." Ralph Budd, defense transportation commissioner, announced that steps were being taken to reclaim street car and railroad rails which have been abandoned and have been left imbedded in the city streets. He estimated that there are 232,000 tons of such material.

(Turn to next left-hand page)

Among the Clubs and Associations

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.—Meeting: November 20, 10 a. m., Ansley Hotel, Atlanta, Ga. Speaker: A. F. Stuebing, development engineer, Carnegie-Illinois Steel Corporation. Subject: Lightweight equipment. Stereopticon illustrations.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Meeting: 8 p. m., November 10, Hotel La Salle, Chicago. Speaker: D. J. Jones, service engineer, Vapor Car Heating Company. Subject: Temperature Control of Passenger-Car Heating.

NEW ENGLAND RAILROAD CLUB.—Meeting: November 12 (instead of November 11, Armistice Day), 6:30 p. m. (dinner), Hotel Touraine, Boston, Mass. Speaker: Kenneth Cartwright, mechanical engineer, N. Y. N. H. & H. Subject: Progress in Steam Locomotive Design.

CANADIAN RAILWAY CLUB.—Meeting November 10, 8:15 p. m., Windsor Hotel, Montreal.—Speaker: J. A. M. Galilee, Westinghouse Air Brake Company. Subject: New tools for Research. Illustrated.

DIRECTORY

The following list gives names of secretaries, dates of next regular meetings, and places of meetings of mechanical associations and railroad clubs:

ALLIED RAILWAY SUPPLY ASSOCIATION.—J. F. Gettrust, P. O. Box 5522, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—C. E. Davies, 29 West Thirty-ninth street, New York. Annual meeting Hotel Astor, New York, December 1-5.

RAILROAD DIVISION.—C. L. Combes, *Railway Mechanical Engineer*, 30 Church street, New York City. Railroad Division sessions at annual meeting of society, Hotel Astor, New York, December 4.

MACHINE SHOP PRACTICE DIVISION.—Warner Seely, Warner & Swasey Co., 5701 Carnegie avenue, Cleveland, Ohio.

MATERIALS HANDLING DIVISION. — F. J. Shepard, Jr., Lewis-Shepard Co., Watertown Station, Boston, Mass.

OIL AND GAS POWER DIVISION.—L. N. Rawley, Jr., Power, 330 West Forty-second street, New York.

FUELS DIVISION.—D. C. Weeks, Consolidated Edison Co., 4 Irving Place, New York.

ANTHRACITE VALLEY CAR FOREMEN'S ASSN.—Frank Kramer, 412 Hill street, Duryea, Pa. Meets third Monday of each month at Wilkes-Barre, Pa.

ASSOCIATION OF AMERICAN RAILROADS.—Charles H. Buford, vice-president Operations and Maintenance Department, Transportation Building, Washington, D. C.

OPERATING SECTION.—J. C. Caviston, 30 Vesey street, New York.

MECHANICAL DIVISION.—A. C. Browning, 59 East Van Buren street, Chicago.

PURCHASES AND STORES DIVISION.—W. J. Farrell, 30 Vesey street, New York.

MOTOR TRANSPORT DIVISION.—George M. Campbell, Transportation Building, Washington, D. C.

CANADIAN RAILWAY CLUB.—C. R. Crook, 4415 Marcil avenue, N. D. G., Montreal, Que. Regular meetings, second Monday of each month, except June, July and August, at Windsor Hotel, Montreal, Que.

CAR DEPARTMENT ASSOCIATION OF ST. LOUIS.—J. J. Sheehan, 1101 Missouri Pacific Bldg., St. Louis, Mo. Regular monthly meetings third Tuesday of each month, except June, July and August, DeSoto Hotel, St. Louis.

CAR DEPARTMENT OFFICERS' ASSOCIATION.—Frank Kartheiser, chief clerk, Mechanical Dept., C. B. & Q., Chicago.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—G. K. Oliver, 8238 S. Campbell avenue, Chicago. Regular meetings, second Monday in each month, except June, July and August, La Salle Hotel, Chicago.

CAR FOREMEN'S ASSOCIATION OF OMAHA, COUNCIL BLUFFS AND SOUTH OMAHA INTERCHANGE.—H. E. Moran, Chicago Great Western, Council Bluffs, Ia. Regular meetings, second Thursday of each month.

CENTRAL RAILWAY CLUB OF BUFFALO.—Mrs. M. D. Reed, Room 1840-2, Hotel Statler, Buffalo, N. Y. Regular meetings, second Thursday of each month, except June, July and August, at Hotel Statler, Buffalo.

EASTERN CAR FOREMAN'S ASSOCIATION.—W. P. Dizard, 30 Church street, New York. Regular meetings, second Friday of January, February (annual dinner), March, April, May, October, and November at Engineering Societies Bldg., 29 West Thirty-ninth street, New York.

INDIANAPOLIS CAR INSPECTION ASSOCIATION.—R. A. Singleton, 822 Big Four Building, Indianapolis, Ind. Regular meetings, first Monday of each month, except July, August and September, in Indianapolis Union Station, Indianapolis, at 7 p. m.

LOCOMOTIVE MAINTENANCE OFFICERS' ASSOCIATION.—J. E. Goodwin, vice-president, secretary-treasurer, c/o Missouri Pacific, North Little Rock, Ark.

MASTER BOILER MAKERS' ASSOCIATION.—A. F. Stiglmeier, secretary, 29 Parkwood street, Albany, N. Y.

MID-WEST AIR BRAKE CLUB.—C. F. Davidson, secretary-treasurer, general inspector car department, St. L.-S. F., Springfield, Mo.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic avenue, Boston, Mass. Regular meetings, second Tuesday in each month, except June, July, August and September.

NEW YORK RAILROAD CLUB.—D. W. Pye, Room 527, 30 Church street, New York. Meetings, third Thursday in each month, except June, July, August, September and December at 29 West Thirty-ninth street, New York.

NORTHWEST CAR MEN'S ASSOCIATION.—E. N. Myers, chief interchange inspector, Minnesota Transfer Railway, St. Paul, Minn. Meetings first Monday each month, except June, July and August, at Midway Club rooms, 1931 University avenue, St. Paul.

NORTHWEST LOCOMOTIVE ASSOCIATION.—G. T. Gardell, 820 Northern Pacific Building, St. Paul, Minn. Meetings third Monday of each month, except June, July and August.

PACIFIC RAILWAY CLUB.—William S. Wollner, P. O. Box 3275, San Francisco, Cal. Monthly meetings alternately in northern and southern California.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 1647 Oliver Building, Pittsburgh, Pa. Regular meetings, fourth Thursday in month except June, July and August, Fort Pitt Hotel, Pittsburgh, Pa.

RAILWAY FUEL AND TRAVELING ENGINEERS' ASSOCIATION.—T. Duff Smith, Room 811, Utilities Building, 327 South La Salle street, Chicago.

RAILWAY SUPPLY MANUFACTURERS' ASSOCIATION.—J. D. Conway, 1941 Oliver Building, Pittsburgh, Pa.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.—A. T. Miller, P. O. Box 1205, Atlanta, Ga. Regular meetings, third Thursday in January, March, May, July and September. Annual meeting, third Thursday in November, Ansley Hotel, Atlanta, Ga.

TORONTO RAILWAY CLUB.—D. M. George, Box 8, Terminal A, Toronto, Ont. Meetings, fourth Monday of each month, except June, July, and August, at Royal York Hotel, Toronto.

WESTERN RAILWAY CLUB.—E. E. Thulin, executive secretary, Room 822, 310 South Michigan avenue, Chicago. Regular meetings, third Monday in each month, except June, July, August, September, and January.

* * *

Photo Courtesy New Haven

President H. S. Palmer and Vice-President R. L. Pearson of the New York, New Haven & Hartford examining the first of 1,000 box cars recently delivered by Pressed Steel

(*Turn to next left-hand page*)

NEWS

$25,000,000 for Rail Equipment and Facilities in Lend-Lease Bill

THE new lend-lease bill reported from the House committee on appropriations during the week ended October 11 includes an item of $25,000,000 for railway equipment and facilities. The publication of testimony on the bill showed that Clifton E. Mack, director of the Treasury's Procurement Division had stated that the item was for the purchase of track materials, locomotives, freight cars, shop machinery and equipment, and light railway material and rolling stock.

Asked what was to be done with the foregoing, Mr. Mack stated that it was for the Middle East "theatres of war"—for the extension and maintenance of railroad facilities "in order to make them capable of handling the increased traffic involved in maintaining a modern army in the field." In response to other questions, Mr. Mack said some of the equipment was now being bought, but he didn't think any of it had actually left the country.

Additional Annual Steel Capacity of 10,000,000 Tons

A FURTHER 10,000,000-ton expansion of the nation's annual steel-making capacity has been approved by the Supply Priorities and Allocations Board, and the Office of Production Management has moved to put the decision into effect. SPAB's action came in the form of an approval of a report recommending the 10,000,000-ton increase which had been prepared by W. A. Hauck, OPM steel consultant.

The OPM statement said that the expansion will be started immediately to meet, among others, such shortages as those of plates for ships, railroad equipment, armor plate for tanks, gun mounts, etc. It is estimated that some of the additional 10,000,000-tons capacity can be completed within nine months, and "substantially all of it within two years provided highest priority ratings are assigned to all undertakings." Unless such ratings are assigned, Mr. Hauck said, no further expansion should be started.

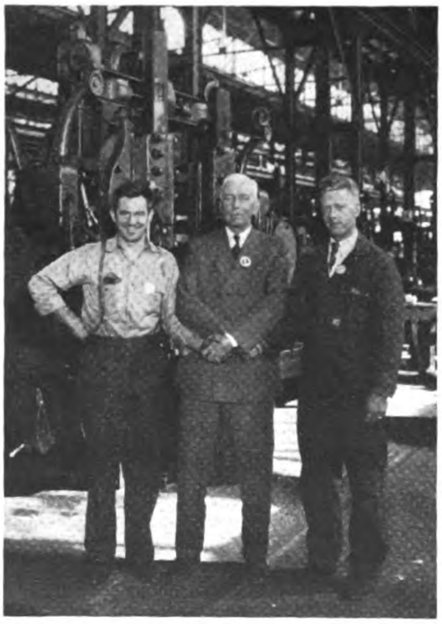
In addition to the 10,000,000-ton increase, Mr. Hauck recommended that another 5,000,000-ton expansion should be undertaken "to the extent that may be found practicable." The latter, however, would not be in the immediate program. Meanwhile the 10,000,000-ton expansion will require construction of more lake ore boats, in addition to the 25 already recommended by OPM to the Maritime Commission.

Dealing with steel-plate capacity, the report cites figures showing that the present rate of demand is 8,500,000 to 9,000,000 tons a year, while present production is at the rate of 6,300,000. Thus the deficiency is "substantially more than 2,000,000 tons." However, additional yearly plate capacity underway or approved will total 2,336,920 tons. In that connection the report says that the program being developed will provide "the balance of ingot capacity needed on the above and also the ingot and plate capacity further needed."

The OPM statement pointed out that the steel required to build the new 10,000,000-ton capacity "must be obtained by a corresponding reduction in steel available for civilian uses while the construction is under way." In other words 1.3 per cent of the present capacity must be thus set aside during each of the next two years; but "this will be returned many times over during subsequent years."

Baldwin School Shop Turns Out 1000th Skilled Worker

THE Baldwin Locomotive Works recently graduated the 1,000th student from its school-shop at Eddystone, Pa., which was opened on October 18, 1940, in anticipation of the present emergency and shortage of skilled workers. By November of 1940 the Baldwin school was operating 24 hours daily under the direction of A. L. Logan, formerly superintendent of the Williamson Trade School. In 11 months it has turned out 1,000 capable machine-tool operators.



Edward W. Thompson (left) the 1000th man to graduate from the training school-shop, organized to produce skilled workers for the production of armaments and conducted by The Baldwin Locomotive Works—Ormus M. Mills, to the right of Charles E. Brinley, president of the company, was the first graduate of the school-shop.

Early this year arrangements were made for "pre-employment" instruction in the schools of Philadelphia and Delaware counties through state employment offices under federal sponsorship. After the proper period of instruction, the students finish their training with an intensive course of instruction at the Baldwin school-shop, and are immediately put to work in the Baldwin plant as helpers and eventually as full-fledged operators of various machines. This so-called "vestibule" training has cut the time spent by learners in the school shop in half. Students in the Baldwin school are not taught to be all-around machinists, but are given specialized training in the operation of one type of machine. This makes for speed, and a more highly developed degree of skill. One man is taught the operation of a milling machine, another a drill press, others are trained to efficiently operate slotters, planers, grinders, automatic screw machines, etc.

The Standard Steel Works division of Baldwin received, on September 16, a Navy "E" pennant and Bureau of Ordnance flag, which were presented to Charles E. Brinley, president of the Baldwin Locomotive Works, by Rear Admiral P. E. Pettengill, commandant of the Navy Yard and superintendent of the Naval Gun Factory, Washington, D. C. Formerly an honor bestowed only on Navy personnel, the pennant was presented to Standard Steel for excellence and efficiency in supplying material for national defense. Three thousand employees, officers and their families were at the presentation.

Alco-G. E. Railroad Movie

A 30-min. sound motion picture in color entitled "Railroadin'" is being made available by the American Locomotive Company and the General Electric Company for showing by the railroads. The film, produced by a Hollywood company, was witnessed for the first time by a group of newspaper men and railroad public relations officers in New York on October 3.

"Railroadin'" was made by the American Locomotive Company and General Electric in co-operation with the railroads, for use by the latter for educational purposes in schools, colleges and clubs. The film (which is in 16 mm. sound only) is available to railroads at no cost other than charges incidental to shipping and may be obtained at the headquarters of American Locomotive Company, 30 Church street, New York, or the Visual Instruction Section, General Electric Company, Schenectady, N. Y. In addition the film will be available in the district offices and plants of Alco at Atlanta, Ga., Chicago, Richmond, Va., St. Louis, Mo., San Francisco, Calif., and Washington, D. C. and district

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offices of G. E. at Atlanta, Ga., Boston, Mass., Chicago, New York, Cleveland, Ohio, Dallas, Tex., Denver, Colo., Los Angeles, Calif., Philadelphia, Pa., Portland, Ore., and Salt Lake City, Utah. For a moderate service charge the film may also be obtained from the Department of Visual Instruction, University of California, Berkeley.

The film cast includes a number of well-known Hollywood actors and a big cast of extras—but the main actors are the American railroads themselves. The film shows America in pre-railroad days; the early struggles of the roads for recognition, and a present-day railroad operation.

New Metal Substitute Developed by U. S. Rubber

DEVELOPMENT of a new non-metallic material one-third lighter than aluminum and designed to replace strategic metals in many important applications was announced on October 3 by the United States Rubber Company. The new substance, which is made from fibrous and rubber-like ingredients, has already been tested and approved by the United States Army, according to the announcement. Of prime importance in the present emergency is the fact that except for small amounts of rubber the new formula is made of non-strategic materials, and will not be affected by priorities.

The new material, which is known simply as Formula C-102, has a number of important qualities. Under gunfire, for example, it resists ripping or shattering. It will not crystallize from vibration as do metallic substances and is free from corrosion and pin-hole formation. Discovery of the new substance was made while members of the research department were working on bullet-puncture-sealing fuel tanks for airplanes developed by the company, in the search for a container for the tanks which would have all the advantages of aluminum, including lightness, yet have greater resistance to shattering and flowering when struck by bullets. The company believes that, in addition to this and many other contemplated defense uses, the new material will find many applications in normal industry.

Copper Priorities Order

THE Division of Priorities, Office of Production Management, has imposed additional rigid controls on copper and brass, issuing Conservation Order M-9-c which virtually forbids the use of copper for many civilian products. The OPM announcement, made October 21, calls the order "the most far-reaching action of its kind yet taken."

The order sets up these controls over both domestic and imported metal and scrap: (1) Use of copper in more than a hundred civilian articles is restricted to approximately 60 per cent of a 1940 base period until January 1, 1942; (2) use of copper in the manufacture of the articles listed is prohibited after January 1, 1942, except for non-decorative plating; (3) use of copper in building construction is prohibited after November 1, 1941; (4) use of copper in all items not listed is reduced to 70 per cent of a 1940 base period.

The prohibited list includes seven general categories: Building supplies and hardware; house furnishings and equipment; dress accessories; jewelry, gifts and novelties; burial equipment; automotive, trailer and tractor equipment, and a miscellaneous list which runs from fire-fighting apparatus to toys. Seven exceptions are made. Restrictions do not apply to Army, Navy, lend-lease or other government defense agency contracts where the use of copper is specified; to products covered by underwriter or other safety regulations in effect on October 1, 1941; to copper used as a conductor of electricity; in chemical plants where corrosive action makes other materials impractical; in research laboratories; for condenser or heating exchanger tubes and tube sheets in steam generating plants and oil refineries where corrosive action invalidates the use of other materials, and in hydro-electric plants.

Reasons for the order, the announcement said, "are readily apparent in supply and demand figures for October, 1941." Army, Navy, lend-lease and other primary defense agency demands for the month total 144,430 short tons. Total demand, including civilian, is 259,479 tons. Total production for the month, domestic, foreign and scrap, is 138,700 tons. And "estimates for 1942 show a continuing serious situation."

Present Status of Freight-Car Building Program

IN an article in the Railway Age of October 11 the events leading up to the present status of the railway freight-car building program to meet the needs of the national emergency are reviewed and the actual status of the program measured against the planned estimated production. The essential facts of the situation are presented in the following table which was taken from that article.

A.C.F. Increases Tank Production

THE American Car and Foundry Co. delivered its 2,000th combat tank to the United States Army on October 21, less than three months after completing delivery of its first 1,000 tanks on August 2. In this short period the company has thus equalled its production for the preceding twelve months—a four-fold speed-up.

The company also reports receipt of an order from the United States Government for an additional 1200 12½-ton light combat tanks at cost of about $31,000,000, part of which order includes spare parts and repair parts. About 900 of these tanks will use gasoline engines and 300 will be Diesel-equipped.

The American Car and Foundry Co. has also supplied large quantities of tank suspensions and tank parts to the British.

Carl R. Gray, Jr., Explains Military Railway Service

IN a recent address before the Telegraph and Telephone section of the Association of American Railroads at Cincinnati, Ohio, Col. Carl R. Gray, Jr., executive vice-president of the Chicago, St. Paul, Minneapolis & Omaha, and manager, Military Railway Service, explained the present organization of the Military Railway Service, which is assigned the operation of railway systems in combat zones forward of the area allowed for commercial operations. He said, in part, as follows:

"The operation and maintenance of standard military railways is a function of special Engineer Railway troops. Original railway construction and the reconstruction of an existing line is the function of general Engineer troops. The Chief Engineer, Theater of Operation, exercises supervision over all military railways in the

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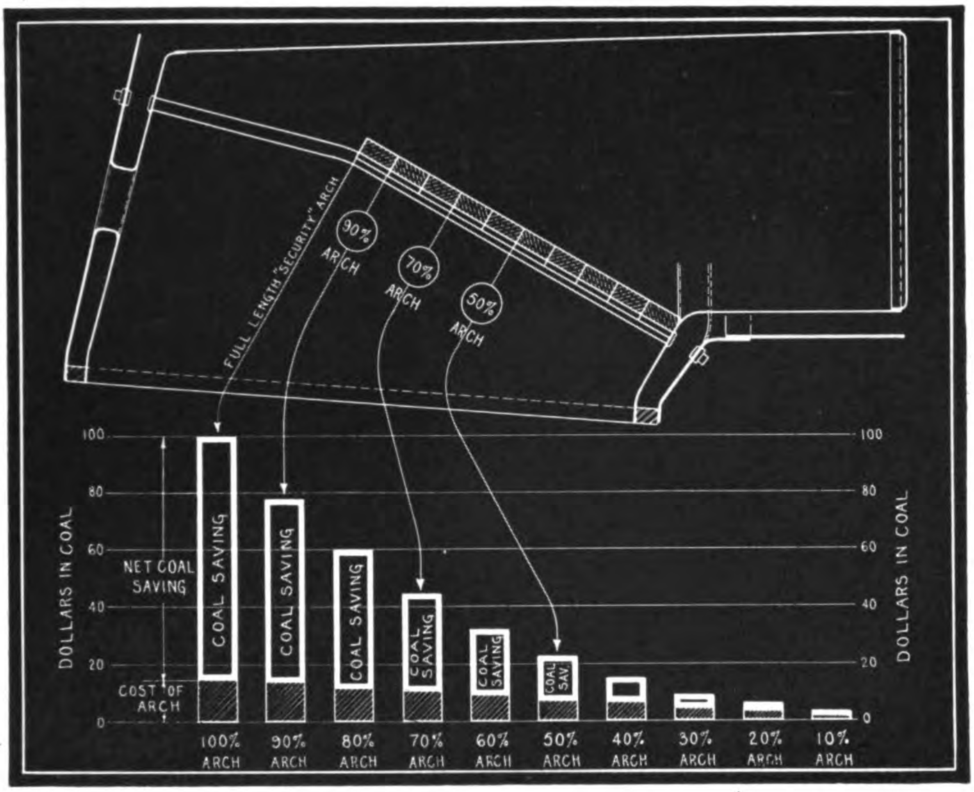
Domestic Freight Car Deliveries Compared with Orders and Planned Production

Data Covers Car Builders Only
January, 1940 to September, 1941

1940	Orders Placed	Deliveries: Number	Deliveries: Per cent of Rated Operating Capacity (A)	Planned Estimated Production (B)	Loss in Production (Planned Production Less Deliveries)	Backlog of Unfilled Orders
January	197	5,084	35.6	....	....	20,229
February	166	5,142	36.0	....	....	15,253
March	1,404	6,548	45.8	....	....	10,109
April	792	5,400	37.8	....	....	5,501
May	2,212	3,061	21.4	....	....	4,752
June	4,329	1,478	10.3	....	....	8,603
July	5,766	1,543	10.8	....	....	12,826
August	4,024	2,356	16.5	....	....	14,500
September	8,543	2,844	19.9	....	....	20,746
October	8,674	3,586	25.1	....	....	25,947
November	7,012	3,981	27.8	....	....	30,362
December	5,476	4,293	30.0	....	....	34,205
Total, 1940	48,595	45,316	26.4			
1941						
January	6,299	4,993	34.9	....	....	34,384
February	2,728	4,057	28.4	....	....	32,991
March	9,440	4,987	34.9	....	....	37,359
April	12,478	5,300	37.1	....	....	44,707
May	19,513	4,670	32.7	6,500	1,830	59,104
June	15,341	5,130	35.2	7,500	2,370	69,355
July	6,449	5,467	38.2	10,000	4,533	70,330
August	3,145	3,856	27.0	12,000	8,144	69,307
September	600	5,044	35.3	14,000	8,956	65,230
Total, nine m s. 1941	75,993	43,504	33.8			

(A) Based upon rated operating capacity for all builders of 14,300 cars.
(B) Based on carbuilders' plans for increased production effective May, 1941.
Planned production called for deliveries during the remainder of 1941 as follows: October, 15,000; November, 16,000; December, 17,000.



THE EFFECT OF ABBREVIATED ARCHES ON FUEL SAVING

theater of operations. The Engineer, Communications Zone, is responsible for the construction and reconstruction of all railways in the communications zone and for the operation and maintenance of all military railways in the entire theater of operations. This operation and maintenance of military railways falls to the Military Railway Service.

"Fundamentally, there is not much difference between the organization and functions of the Military Railway Service and the organization and manner of functioning of the Operating department of a standard steam railroad. Basically, the Manager, Military Railway Service, who has a wartime rank of Brigadier General, corresponds to the operating vice-president of any of our large American railroads. His headquarters are divided into a small headquarters detachment; and Operations department, looking after transportation and the movement of trains; an Equipment department, charged with the responsibility for the maintenance of locomotives and cars; a Track and Structures department, charged with the responsibility for the maintenance of the roadbed, bridges, signals and buildings; and a Stores department. Even the designated titles of the commissioned personnel are equivalent to the railroad positions held by the assistants, or staff, of the Manager.

"Depending upon the scope of the operations, the Manager, Military Railway Service will divide into grand divisions the standard military railway system to be operated. This Engineer Headquarters, Railway Grand Division, is commanded by a Colonel with the railroad title of general superintendent, and that headquarters is likewise divided into an Administrative section, a Transportation section, a Water Treatment section, an Engineering section, an Equipment section and a Stores section, and corresponds to a general manager's jurisdiction on an American commercial railroad.

"Depending upon the circumstances, a grand division is comprised of two or more railway divisions, each operated and maintained by a Railway Operating battalion, whose commander is a division superintendent with the rank of Lieutenant Colonel. These Engineer battalions, Railway Operating, are divided into a Battalion headquarters; a Headquarters and Service company; Company A, Maintenance of Way; Company B, Maintenance of Equipment; and Company C, Transportation. They correspond almost identically to the ordinary division superintendent's jurisdiction on an American commercial railroad.

"The Engineer battalions, Railway Shop, are organized along the lines of a standard back shop on any American steam railroad, and the battalion consists of an Erecting and Machine Shop company, a Boiler and Blacksmith Shop company, and a Car Repair company. The commander of this battalion is a Lieutenant Colonel, who shall be either an experienced superintendent of motive power and machinery, or a shop superintendent of a back shop on one of our big railroads. The location of these Shop battalions shall be determined by the Manager, Military Railway Service, and they shall be so situated as to take care of the heavy repairs of one or more grand division.

"It will be seen, then, that the policy of the War Department—which the American railroads have readily agreed to—is today to have the Military Railway Service of the army officered by practical railroad officers who will have appropriate ranks in the army and designated titles corresponding to the positions they occupy on an American railroad. . . . The officers of these Military Railway Service units are specialists in transportation and maintenance of equipment and way, and are capable of performing a real transportation service for the army. Assigned to each unit will be at least one regular army officer for liaison and a better understanding of the military side of the operations by the practical railroad men."

Iron and Steel Scrap Under Priority Control

Donald M. Nelson, director of priorities, Office of Production Management, in an order effective October 11, has placed iron and steel scrap under full priority control.

This order, designed to relieve serious day-to-day shortages, authorizes the director of priorities to issue specific directions for deliveries of scrap. The order further provides that producers, dealers and brokers, and consumers of iron and steel scrap shall make monthly reports to the Priorities Division. Beginning November 15, producers will be required to report scrap inventories, production and sales; brokers will show inventories, purchase, and sales; and consumers must indicate inventories, production, receipts, and consumption of scrap metal. It is expected that, on the basis of these reports, a general policy for the distribution of scrap under mandatory orders, will be developed.

Scrap is defined in the order as "all ferrous materials, either alloyed or unalloyed, of which iron or steel is a principal component, which are the waste of industrial fabrication, or objects that have been discarded on account of obsolescence, failure or other reason."

The order emphasizes that the provisions of Priorities Regulation No. 1 apply to ferrous scrap. These provisions include prohibition of excess inventory, and stipulate that intra-company deliveries are subject to the same requirements that apply to inter-company deliveries.

Orders and Inquiries for New Equipment Placed Since the Closing of the October Issue

Locomotive Orders

Road	No. of Locos.	Type of Locos.	Builder
Atlantic Coast Line	2	1,000-hp. Diesel-elec.	Baldwin Loco. Wks.
Bethlehem Steel Co.	1	0-6-0	Vulcan Iron Works
Chicago & Northwestern	1	380-hp. Diesel-elec.	Whitcomb Loco. Co.
Chicago Short Line	1	1,000-hp. Diesel-elec.	Baldwin Loco. Wks.
U. S. Army	1	80-ton Diesel-elec.	General Electric Co.
	1	45-ton Diesel-elec.	
U. S. Army, Engineering Dept.	1	45-ton Diesel-elec.	Vulcan Iron Wks.
U. S. Navy Dept.	1	30-ton Diesel-elec.	Fate-Root-Heath Co.
	1[1]	Fireless-steam	H. K. Porter Co.

Locomotive Inquiries

Road	No. of Locos.	Type of Locos.	Builder
Bessemer & Lake Erie	2	2-10-4	....
	2	0-8-0	....
Duluth, Missabe & Iron Range	5	2-8-8-2	....
U. S. Navy Dept.	11	Diesel-elec.	....
U. S. War Dept.	5-25[2]	2-8-8-2	....

Freight-Car Orders

Road	No. of Cars	Type of Cars	Builder
Birmingham Southern	100	50-ton box	
	100	70-ton gondola	Pull.-Std. Car Mfg. Co.
	10	50-ton cement	
Boston & Maine	10	Cabooses	Pull.-Std. Car Mfg. Co.
Chicago Great Western	200	50-ton merchandise	Pull.-Std. Car Mfg. Co.
Pittsburgh & West Virginia	100	50-ton box	Company shops
U. S. Navy Dept.	3	50-ton flat	
	1	50-ton box	Haffner-Thrall Car Co.

Freight-Car Inquiries

Road	No. of Cars	Type of Cars	Builder
American Steel & Wire Co.	65[3]	70-ton gondola	....
	8	50-ton air-dump	....
Bessemer & Lake Erie	425[3]	90-ton hopper	....
	500	50-ton gondola	....
Carnegie-Illinois Steel Corp.	10[3]	50-ton air-dump	....
	10	70-ton air-dump	....
Central R. R. of N. J.	50	70-ton cement	....
Elgin, Joliet & Eastern	1,000[3]	50-ton gondola	....
	200	50-ton flat	....
Michigan Limestone & Chemical Corp.	10[3]	Air-dump	....
National Tube Co.	3[3]	50-ton gondola	....
	75	70-ton gondola	....
	4	50-ton hopper	....
	10	70-ton hopper	....
Tennessee Coal, Iron & R. R.	10[3]	70-ton hopper	....

Passenger-Car Orders

Road	No. of Cars		
Boston & Maine	21	All-steel baggage	....

[1] Cost, $19,960.
[2] For the Yunnan-Burma Railway in China. The materials for these locomotives are to receive an A-1-i priority rating.
[3] Purchase planned by U. S. Steel Corp.

Meanwhile, the Office of Price Administration has issued an amendment to the scrap schedule setting up Cincinnati, Ohio, as a basing point for scrap of railroad origin. The addition of Cincinnati as a basing point for railroad scrap, it was explained, represents a further refinement of the schedule, and places railroads in that area on a parity with sellers of industrial scrap.

OPA To Fix Prices of Carbon and Low-Alloy Steel Castings

MAXIMUM prices for carbon and low-alloy steel castings, "including railway specialties," will be established at or below current levels, it was announced September 30 by Leon Henderson, administrator of the Office of Price Administration.

Plans for the schedule, the OPA announcement said, have been discussed with representatives of 60 large and small producers; a separate session was held with the makers of railway specialties. Further discussions will take place with a representative committee which OPA is selecting "in order that the schedule of maximum prices may conform as closely as possible to present trade practices and methods." Consultation also will be had with buyers of castings before the ceiling is formulated.

The announcement went on to say that the general level of carbon and low-alloy steel casting prices has risen about 15 per cent thus far in 1941. It added that "because of the importance to industry, and particularly to the defense program," OPA "feels that a price ceiling should be established at or below the levels now prevailing."

A.A.R. Lumber Specifications

AT a joint meeting of the Car Construction Committee of the Association of American Railroads and representatives of the lumber manufacturers, the following six suggestions were advanced, not with the thought of making them mandatory or permanent practice, but simply for the duration of the present emergency and to help solve the problem of securing lumber required for new equipment and repairs:

(1) It is suggested that the demand for edge grain material be confined to sections requiring wearing material, and not be insisted upon for lining and interior roofing.

(2) Require edge grain or heartwood only for the kind of wood and for the part of a car where either is absolutely necessary.

(3) Some railroads order select grades for use in repairs instead of common grades as recommended in A. A. R. Specification M-907-33. Under present conditions that procedure is undesirable. The supply situation in the lumber industry possibly would be better served if the common grades were substituted for the select grades in the flooring, lining and inside roofing of repaired cars.

(4) As an emergency proposition only, on new and existing cars where it is possible, lining of double sheathed cars to be ordered in two pieces in varying lengths of six feet and up, and applied to suit nailing post spacing. This does not apply to single sheathed cars. In view of the present emergency this arrangement is brought to the attention of the individual railroads for such action as they see fit.

(5) The "Use Classification" on pages 4 and 5 of Specification No. M-907-33 provides for several kinds of wood suitable for each detail part. Because so many railroads have limited their acceptable woods it is suggested that, in view of the present emergency, mechanical officers give consideration to other suitable woods shown in the specification.

(6) Wherever it is practicable inspection to be made by authorized lumber inspectors at point of origin rather than at destination, also for railroads not equipped to make such inspection, that arrangements be made for such inspection by authorized inspectors of other railroads located in the vicinity of the district from which lumber is being shipped. The lumber manufacturers believe this will avoid rejections at destination. This arrangement might be agreeable to some railroads under the present emergency and is a matter for decision of individual railroads.

War Department Purchases Rail Equipment

PURCHASES of railroad equipment for the War Department by The Quartermaster General during the fiscal year ended July 1 amounted to $2,994,991, according to a statement recently released. This figure compares with purchases during the entire 10-year pre-emergency period from 1930 through 1939 of only $179,988.

The 1940-41 report, itemizing rail equipment purchased during the year, shows an expenditure of $1,026,395 for 65 gasoline-driven 20-ton locomotives. Other locomotives purchased were two 100-ton, three 60-ton, 10 45-ton, two 30-ton and two 20-ton units. In addition, the year's acquisitions include 260 tank cars, two railroad hospital unit cars and 19 25-ton locomotive cranes.

The major portion of the railroad equipment purchased by The Quartermaster Corps is used in government-owned yards of facilities serving military camps, posts, stations and depots for moving cars where this can be done either more speedily or at less cost than with equipment owned by common carriers, or where the use of railroad-owned equipment would interfere with the handling of civilian traffic, it was pointed out. The locomotive cranes are used to unload heavy items such as combat tanks, automobiles, structural steel, etc.

Equipment Purchasing and Modernization Program

Chicago, Milwaukee, St. Paul & Pacific.—The C. M., St. P. & P. has asked the Interstate Commerce Commission for authority to assume liability for $2,744,000 of equipment trust certificates, maturing in 14 equal semi-annual instalments of $196,000 on May 1 and November 1, beginning May 1, 1942, and ending November 1, 1948. The proceeds will be used as 50 per cent of the purchase price to finance the construction in the company's own shops of new equipment costing a total of $5,488,750 and consisting of 1,000 40 ft. 6 in., all-steel box cars; 500 40 ft. 6 in., all-steel automobile cars; 500 50-ton self-clearing hopper coal cars; and 25 steel cabooses.

Erie.—The Erie is building new car repair yard facilities at Marion, Ohio, and a new coaling station for the eastbound main track at Kent, Ohio. The work is being done by company forces.

Florida East Coast.—Receivers for the Florida East Coast have applied to the Interstate Commerce Commission for approval of a plan whereby they would issue $1,000,000 of 2¾ per cent equipment trust certificates, series J, to be sold to the Reconstruction Finance Corporation at par for the purpose of financing approximately 90 per cent of the cost of three Diesel-electric locomotives, 60 freight cars, and six stainless-steel passenger-train cars. The certificates would mature in 20 semi-annual installments on each May 1 and November 1 from 1942 to 1951.

Missouri Pacific.—The Missouri Pacific has asked the Interstate Commerce Commission for authority to assume liability for $4,185,000 of equipment trust certificates, maturing in 15 equal annual installments of $279,000 on November 1 in each of the years from 1942 to 1956, inclusive. The proceeds will be used as 75 per cent of the purchase price of new equipment costing a total of $5,596,461 and consisting of 100 50-ton, 50 ft. 6 in. auto-parts cars; 50 70-ton covered cement cars; 800 50-ton, 40-ft. 6 in., all-steel sheathed box cars; 200 50-ton, 50 ft. 6 in. automobile cars; and 500 70-ton, 40 ft. 8 in. hopper cars.

Reading.—The board of directors of the Reading have authorized the construction of 1,000 steel hopper coal cars of 55-tons' capacity at an estimated cost of $2,500,000. E. W. Scheer, president of the railroad, announced that the cars would be built in the company's own shops at Reading, Pa., "if and when material becomes available."

Seaboard Air Line.—Receivers for the S. A. L. have applied to the Interstate Commerce Commission for approval of a plan whereby they would issue $3,552,000 of 2½ per cent equipment trust certificates, series KK, to be purchased at par by the Reconstruction Finance Corporation or sold with the guarantee of that agency. The certificates would mature in 24 semi-annual installments of $148,000 each on April 1 and October 1 of each year from April 1, 1942, to October 1, 1953. The equipment, to be purchased at a total cost of $4,838,479. Orders for this equipment were published in the August *Railway Mechanical Engineer.*

Union Pacific.—The U. P. has applied to the Interstate Commerce Commission for authority to issue $13,250,000 of 1¼ per cent equipment trust certificates, series G, to finance in part the acquisition of equipment which will cost approximately $16,562,500. The equipment includes 2,000 steel box cars to be built in company shops, and the following to be acquired from builders: 20 4-6-6-4 locomotives, 30 mixed chair cars, 30 baggage cars, 10 mail-baggage cars, 100 cabooses.

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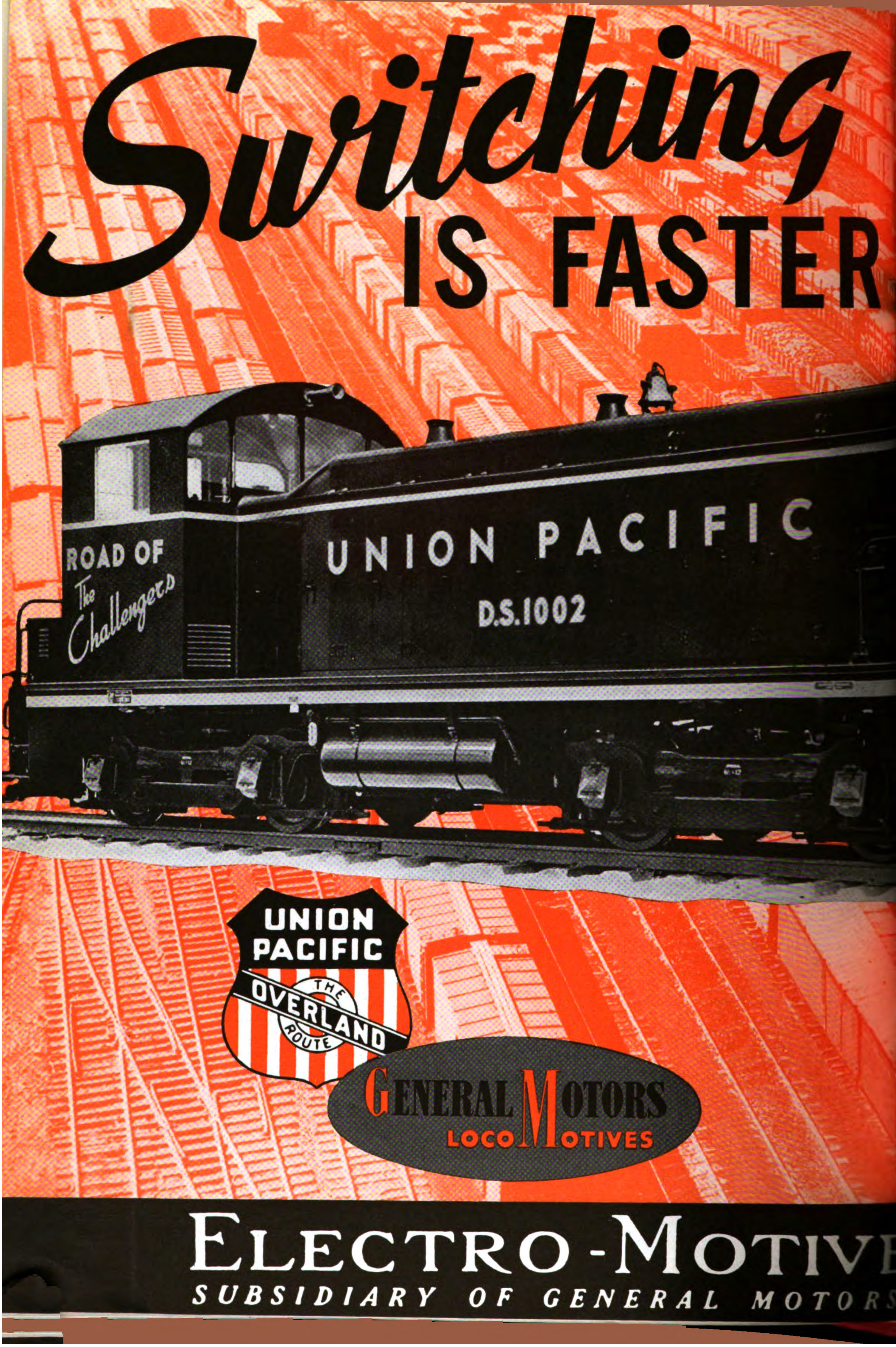
Switching
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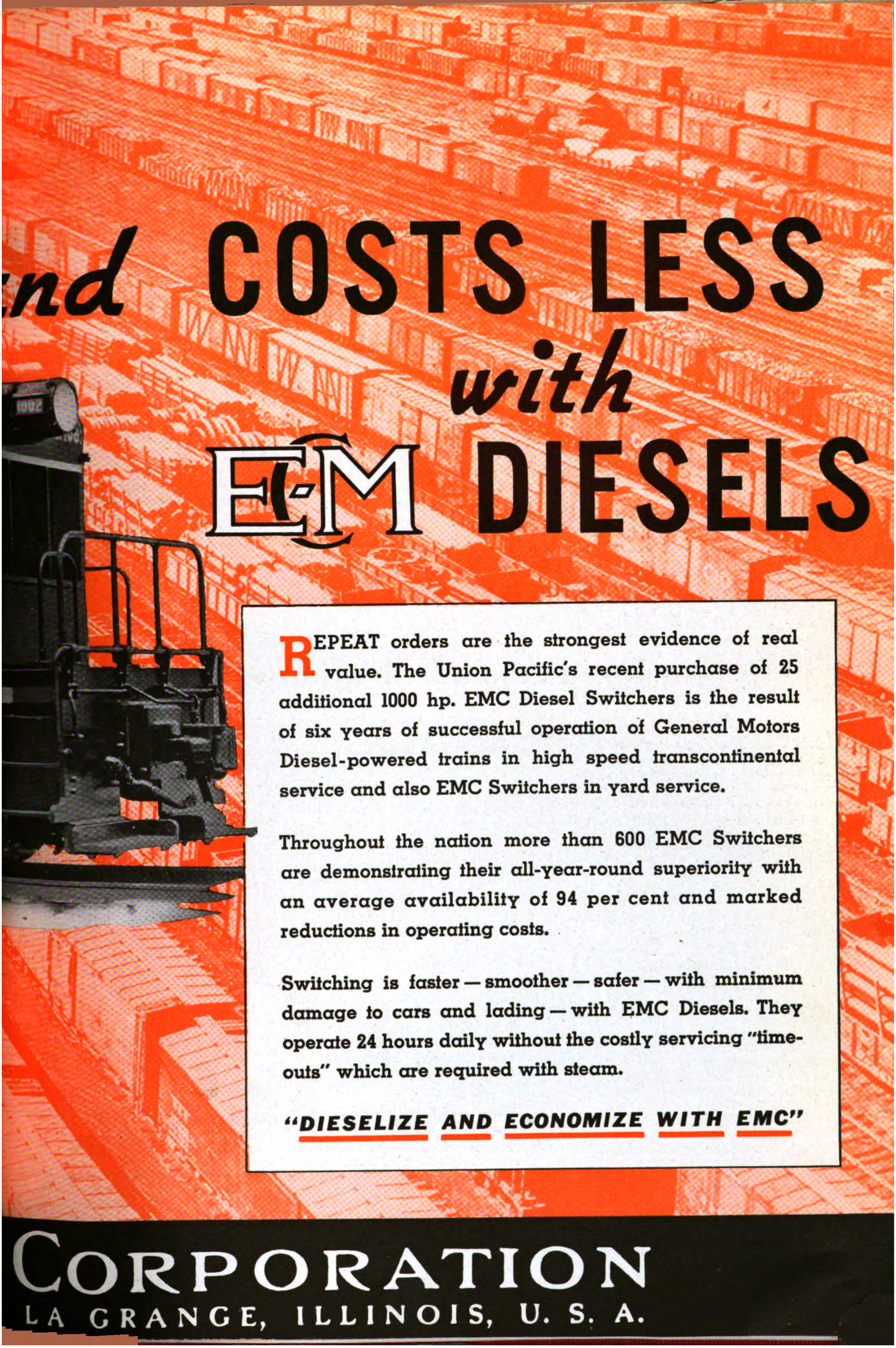

...nd COSTS LESS with
E-M DIESELS
REPEAT orders are the strongest evidence of real value. The Union Pacific's recent purchase of 25 additional 1000 hp. EMC Diesel Switchers is the result of six years of successful operation of General Motors Diesel-powered trains in high speed transcontinental service and also EMC Switchers in yard service.
Throughout the nation more than 600 EMC Switchers are demonstrating their all-year-round superiority with an average availability of 94 per cent and marked reductions in operating costs.
Switching is faster — smoother — safer — with minimum damage to cars and lading — with EMC Diesels. They operate 24 hours daily without the costly servicing "time-outs" which are required with steam.
"DIESELIZE AND ECONOMIZE WITH EMC"
CORPORATION
LA GRANGE, ILLINOIS, U. S. A.
1002

Supply Trade Notes

C. C. CLARK, sales manager of the Central district of the Pressed Steel Car Company, Inc., with headquarters at Pittsburgh, Pa., has been appointed sales manager of the Western district, with headquarters at Chicago.

◆

MANNING, MAXWELL & MOORE, INC.—*Harry G. Johnson* has been appointed salesman for the Indianapolis, Ind., territory of Manning, Maxwell & Moore, Inc., to succeed *Gerald Beebe*, who has been granted an extended leave of absence due to illness.

◆

COOPER-BESSEMER CORP.—*B. B. Williams*, chairman of the board of the Cooper-Bessemer Corporation has again taken over the duties of the president, succeeding *Charles B. Jahnke*, deceased. *Gordon LeFebvre*, vice-president and general manager and *L. F. Williams* have been elected directors of this corporation.

◆

THE COLUMBIA STEEL COMPANY, subsidiary of the United States Steel Corporation, is planning a program to increase the capacity of its Pittsburg, California plant. The program includes the addition of a new semi-continuous rod mill, together with billet heating furnaces, rod cooling and handling equipment. The rod mill will be housed in a new building to be built east of the plant's open-hearth building. The plant's wire and nail mill will be improved and extended to include additional wire drawing and nail machines, and new facilities for the manufacture of some wire products, the production of which was formerly confined to eastern mills. The warehousing facilities of the wire mill will also be increased and some changes made to the primary rolling mills, allowing production of longer rod billets. The steel-making capacity of the Pittsburg plant is being increased to the extent of 77,000 net tons of ingots annually by the installation of a new open hearth furnace and by an increase in the capacity of the four existing open hearth furnaces. The program will require extension of the plant's open hearth buildings, the addition of new ladles, an additional ladle crane and a new charging machine.

◆

GALE SERVICE & CONSTRUCTION CO.—*W. C. Thatcher*, vice-president of the Gale Service & Construction Co., Chicago, has been elected president, succeeding *Frederick A. Gale* who died on July 10. *O. C. Rome* has been elected vice-president to succeed Mr. Thatcher. Before their connection several years ago with the Gale Service & Construction Co., both Mr. Thatcher and Mr. Rome were associated for 22 years with the National Boiler Washing Company of Illinois.

◆

THE AMERICAN LOCOMOTIVE COMPANY has established a department of information under the direction of *Lynn C. Mahan*, to have charge of all public relations activities and the handling of inquiries from the press and public, seeking information on the company's operations. The new department will have its headquarters at the company's New York office, 30 Church street.

Obituary

FREDERICK W. WERNER, assistant to the president of the United States Steel Corporation in charge of coke by-products sales, died September 29 in the Flushing hospital, Long Island, N. Y., after an illness of several months. He was 52 years of age.

Personal Mention

General

J. W. ECKSTEIN, master mechanic of the Akron, Canton & Youngstown and the Northern Ohio, has been appointed superintendent of motive power, with headquarters as before at Akron, Ohio. This is a change of title.

EDWARD J. BALL, superintendent of shops on the New York, New Haven & Hartford at Van Nest, N. Y., has been appointed superintendent of electric and Diesel locomotive maintenance, a new position, with headquarters at New Haven, Conn.

Master Mechanics and Road Foremen

G. L. FISHER has been appointed master mechanic on the Erie at Buffalo, N. Y.

E. LUNDSTROM has been appointed a road foreman of engines on the Denver & Rio Grande Western with headquarters at Salt Lake City, Utah.

B. E. JONES, master mechanic on the Erie at Buffalo, N. Y., has been transferred to Secaucus, N. J., succeeding C. H. Norton, retired.

JAMES E. FITZGERALD, general foreman of the South Boston, Mass., passenger yards, on the New York, New Haven & Hartford, has been appointed assistant master mechanic of the Boston division.

E. BRANNING has been appointed master mechanic on the Erie at Hornell, N. Y., succeeding E. Pool, who has been granted a leave of absence.

JAMES E. HALL, traveling engineer on the Union Pacific, has been appointed road foreman of engines, at East Pittsburgh, Pa., succeeding John W. Wyke, retired.

HARRY W. MAXWELL, assistant master mechanic of the Boston (Mass.) division, on the New York, New Haven & Hartford, has been appointed master mechanic, with the same headquarters.

Car Department

F. F. LENTZ, assistant master mechanic and general car foreman of the Akron, Canton & Youngstown and the Northern Ohio at Akron, Ohio, has been appointed superintendent of the car department, with headquarters at Akron. This is a change of title.

Shop and Enginehouse

R. H. MICHALEK has been appointed assistant general foreman on the Boston & Albany at West Springfield, Mass.

WALTER R. SEDERQUEST, master mechanic of the Boston (Mass.) division, on the New York, New Haven & Hartford, has been appointed superintendent of the Readville (Mass.) shops.

K. D. READ has been appointed shop superintendent on the Boston & Albany with headquarters at West Springfield, Mass.

L. A. HARTLEY, enginehouse foreman on the Erie at Hornell, N. Y., has been appointed supervisor of apprentices, with headquarters at Cleveland, Ohio.

F. D. DUNTON, supervisor of apprentices on the Erie with headquarters at Cleveland, Ohio, has been appointed general foreman at Avoca, Pa.

JOHN W. O'MEARA, superintendent of the Readville (Mass.) shops on the New York, New Haven & Hartford, has been transferred to the Van Nest (N. Y.) shops.

FRANK C. GOBLE, road foreman of engines, on the New York, New Haven & Hartford, has been appointed general air brake inspector, with headquarters at New Haven, Conn.

JOHN HARTHILL, general boiler foreman of the New York Central at Collinwood, Ohio, has retired. Mr. Harthill is a charter member of the Master Boiler Makers' Association.

T. J. LYON, shop superintendent on the Boston & Albany at West Springfield, Mass., has been appointed general foreman of the locomotive shop on the New York Central with headquarters at West Albany, N. Y.

December
1941

Railway Mechanical Engineer

FOUNDED IN 1832

RAILWAY MECHANICAL ENGINEER

Founded in 1832 as the American Rail-Road Journal

With which are also incorporated the National Car Builder, American Engineer and Railroad Journal, and Railway Master Mechanic. Name Registered, U. S. Patent Office.

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Denver and Rio Grande Western Installs

Two-Car Deluxe Trains

"The Prospectors", built by Budd are driven by Diesel-electric power plants mounted under car-floors and are heated from the engine cooling-water—Coach, sleeping-car, dining, and lounge facilities are provided

THE Denver & Rio Grande Western has purchased two stainless-steel passenger trains of two self-propelled cars each from the Edward G. Budd Manufacturing Company. These trains will be used to provide an overnight service via the Moffat Tunnel route between Denver, Colo., and Salt Lake City, Utah. Each of the two cars in each train is equipped with two Diesel-electric traction power plants which are mounted under the car floor, all under multiple-unit control from the operator's cab at the front end of the train. In the two cars are included coach, open-section sleeping-car, single-bedroom, dining, and lounge facilities. There is also a short luggage compartment at the front end of each train.

The arrangement of facilities in these trains is shown on the floor plans. At the front end is a luggage compartment, with operator's section. Behind the luggage compartment is the coach section, seating 44 passengers. To the rear of the latter are roomy men's and women's dressing rooms with toilets.

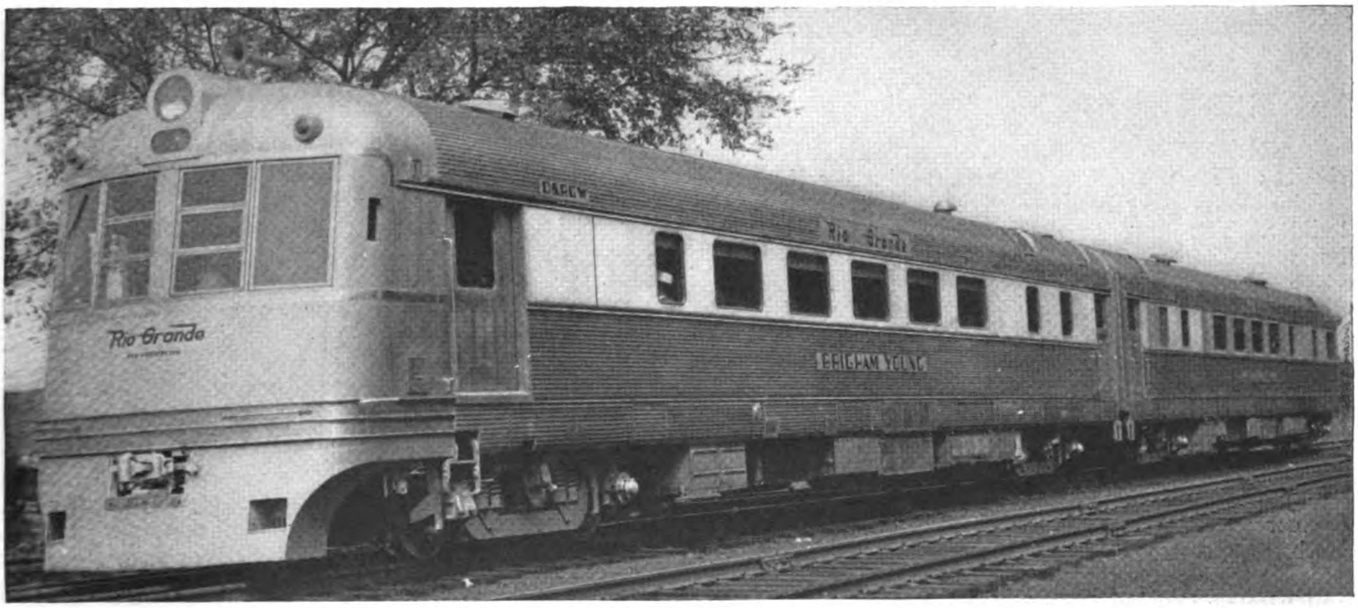
There are vestibule entrances at the rear of the first car and the front end of the second car.

At the front of the second car are women's and men's dressing rooms with toilets. Next is a sleeping-car section with eight upper and lower berths. Behind the open sections are two chambrettes (single-occupancy rooms) each equipped with a folding bed, a folding chair, and complete toilet facilities.

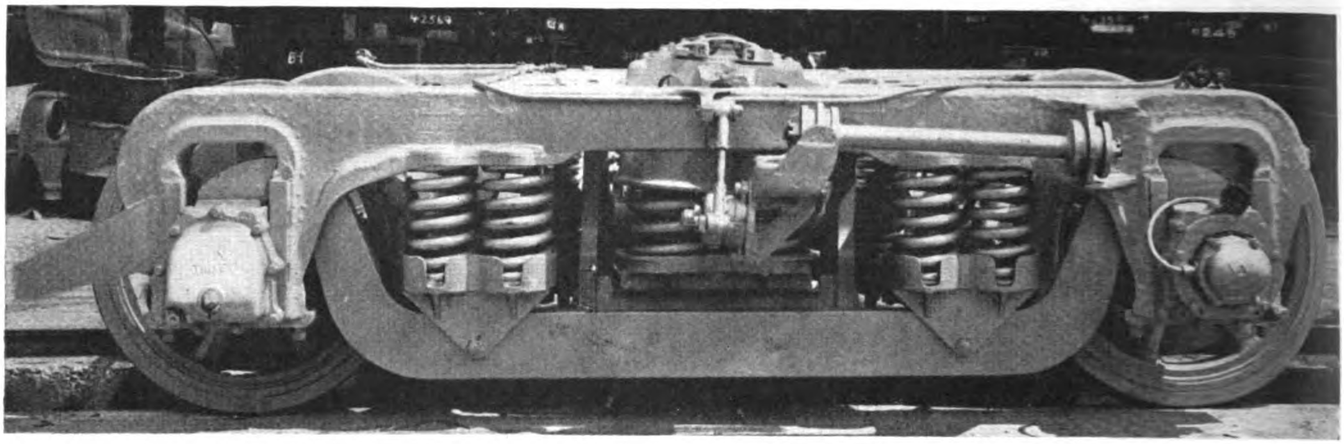
A door between the chambrettes permits them to be combined in a double room of drawing-room size.

Next to the rear is a buffet kitchen. The dinette, which adjoins the buffet to the rear, consists of two sections with tables, one on each side of the car. At the rear of the dinette two observation-lounge seats face the windows around the end of the car.

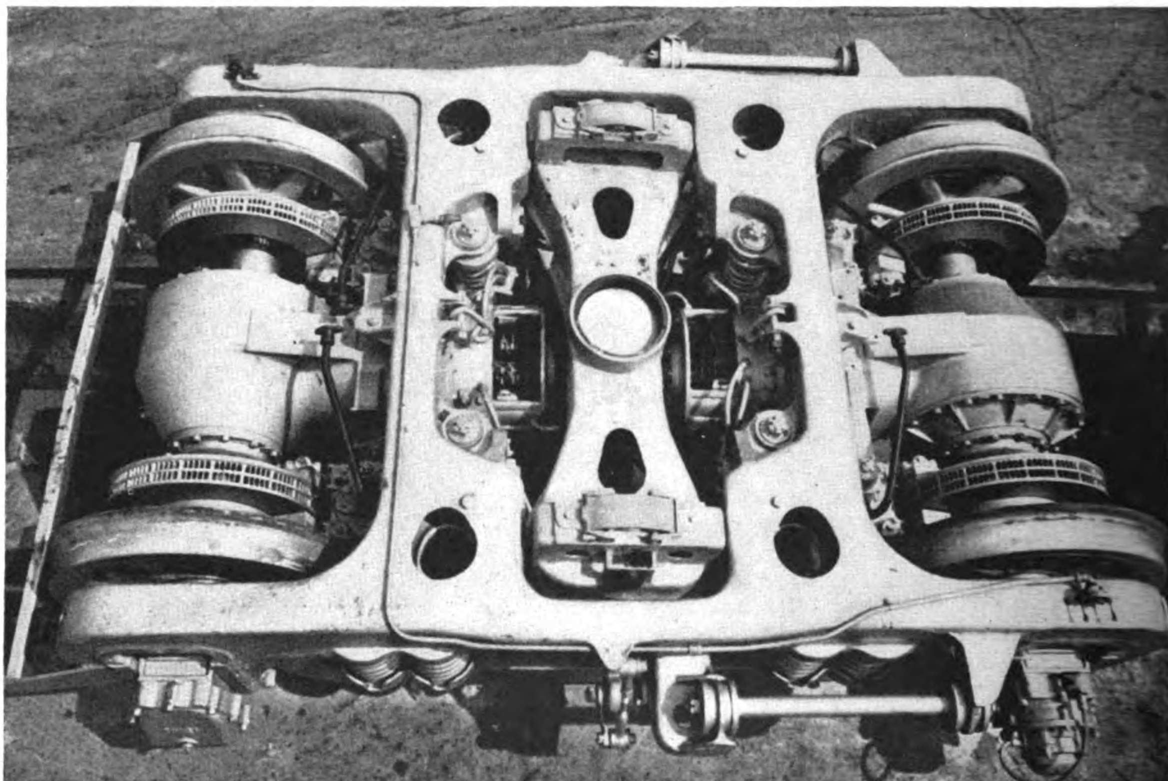
As the trains are designed for operation in one direction only, the double coach seats are not reversible. Each seat has an individual reclining back. The decorations are modern and the colors are in soft tones. The center ceilings are in deep cream with coral on the side ceilings, the under side of the luggage racks and the walls down to the floor. The coral tone is also used in the upholstery. The floor is covered with a jaspe linoleum in driftwood gray with aisle strips in a rectangular pattern



The Prospectors of the D. & R. G. W. are two-car de luxe trains for overnight service between Denver, Colo., and Salt Lake City, Utah



The trucks are the single drop equalizer type with coil springs under the bolsters



Looking down on the truck, showing the motor suspension and the disc brake

of marbleized brown and black. The Pantasote window shades are faced inside with a cream colored self pattern.

The sleeping-car sections were developed by the car builder. The upper berth pushes up toward the ceiling horizontally instead of folding upward at an angle.

The sleeping, dining, and observation sections are decorated in a deep flesh tone on the ceilings with gray blue and pearl gray on the walls, which blend with the same colors on the chairs and seats. In the dinette and observation sections the upholstery is in deep tan leather with terra cotta piping.

Power Plants

The two power plants on each car are mounted under the car at diagonally opposite corners near the trucks. Each power plant is enclosed in a soundproof box and consists of a 192-hp. Hercules Diesel engine with General Electric traction and auxiliary generators, an Exide storage battery, a Schwitzer-Cummins normalizer, a heat exchanger, and a panel board containing switches and gages.

The Diesel engine is of the horizontal type, with six four-cycle cylinders of 5½-in. bore by 6-in. stroke, and a total piston displacement of 855 cu. in. Its full power rating is developed at 1,650 r.p.m. The engines are started by special windings in the traction generator, no separate starting motor being required.

In the run between Denver and Salt Lake City the altitude rises from 5,200 ft. to 9,600 ft. in a distance of 39 miles. The purpose of the normalizer is to maintain normal sea-level air pressure for engine operation irrespective of the altitude. It consists of a two-lobe Roots blower and is belt driven from the traction generator. The blower outlets feed into the engine intake.

Engine cooling is effected by a radiator with two fans directly connected to the auxiliary generator on each engine. A thermal control is set in the radiator outlet to advance the fan speed when the water leaving the

Dimensions and Weights of The Prospector

	Front car	Rear car
Length overall, ft.-in.	75-0	78-0
Width inside, ft.-in.	9-3½	9-3½
Height, rail to top of roof, ft.-in.	12-8 7/16	12-8 7/16
Height, rail to top of floor, ft.-in.	4-3 7/16	4-3 7/16
Height, floor to ceiling, ft.-in.	7-6	7-6
Distance between truck centers, ft.-in.	51-0	54-0
Truck wheel base, ft.-in.	9-0	9-0
Diameter truck wheels, in.	36	36
Journals, nominal size, in.	5½ x 10	5½ x 10
Weights, lb.:		
Total, ready to run	129,820	133,810
Car body, ready to run	84,320	88,310
Trucks	45,500	45,500

radiator rises to a temperature too high to cool the engine. The design is such that the fans operate at the lower speed at all times except when the engine is on full load and the temperature of the atmosphere is above 85 deg. F.

The four power plants on each train are operated through multiple-unit control from a very simple master controller. This may also be used for controlling eight power plants in case a four-car train is desired. The master controller has seven positions which cause the four Bosch engine governors to be set at seven different positions through electro-pneumatic controls. Each position of the controller thus causes the engines to run at one of seven different predetermined speeds ranging from 700 revolutions per minute at idling to 1,650 revolutions per minute at full power output.

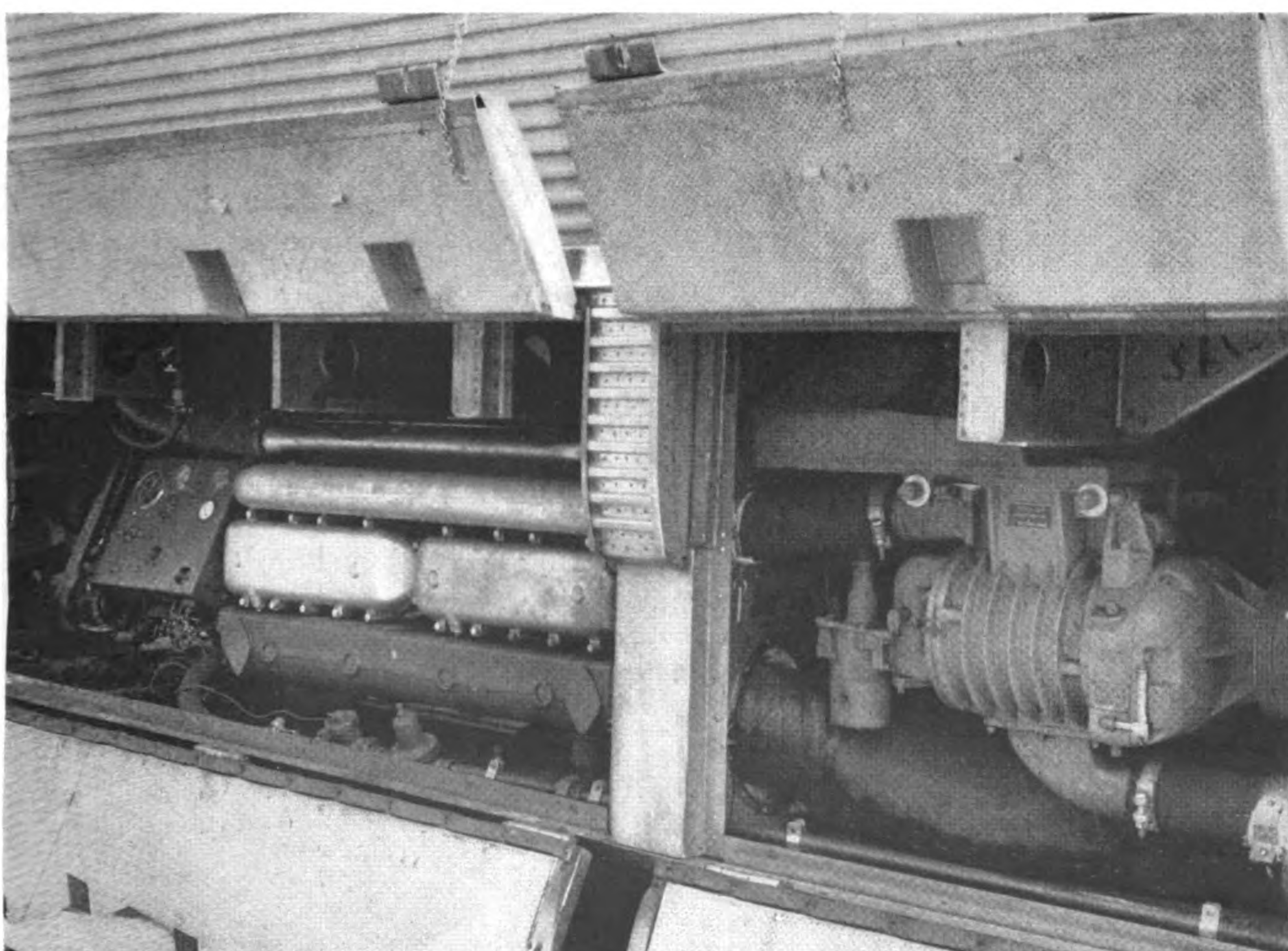
To insure maximum engine performance at each governor-controlled speed, an amplidyne control is employed which causes the generator to produce a predetermined power output at that speed. As the train speed increases or decreases and the traction-motor counter-voltage rises or falls, the amplidyne control varies the relation of generator current and voltage so that the product of these values is constant.

Car Heating, Cooling and Ventilation

The system of temperature and ventilation control in the train is entirely automatic and adjusts itself to heating or cooling by a thermostat in the fresh-air duct. At temperatures below 65 deg. F. the system is set up on the heating cycle and above 72 deg. F. on the cooling cycle. In the range of ambient temperatures between 65 deg. and 72 deg. F. neither heating nor cooling is applied, but a manual switch makes either available if desired.

On the heating cycle a circulating pump is in operation which takes the engine cooling fluid from its normal course to the engine radiator and circulates it through the floor and overhead radiators. On the cooling cycle the circulating pump is shut down and thermostatic connections are made with the Freon compressor.

Since the engine jacket water is used for train heating, the control of the engine-water temperature, therefore, performs an important function in the control of the heating system. A Sylphon engine temperature regulator controls the engine-water temperature so that it will not go below 160 deg. F. The thermal element of



One of the power plants in place underneath the car—At the left, the Diesel engine; at the right, the normalizer

this valve is located in the discharge water line from the Diesel engine and the operation of the valve is such that the water from the engine will either go around a by-pass back to the engine water pump or to the radiator to permit cooling. Variable amounts of the water from the Diesel engine may go to the by-pass and to the radiator simultaneously. When the engine-water temperature is low all the water goes through the by-pass and back to the engine. When the engine temperature is high all the water goes to the radiator and then back to the engine.

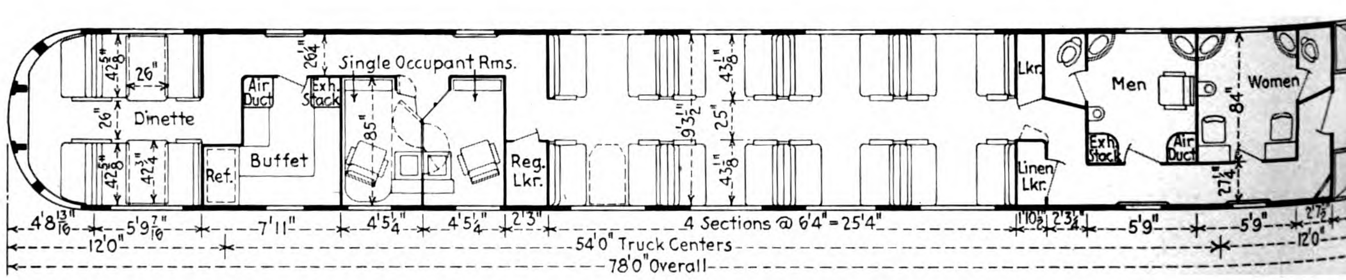
Car cooling is accomplished by Sturtevant electro-mechanical air conditioning with the Fulton-Sylphon electric control. The compressor is a four-cylinder machine driven by a General Electric dual motor consisting of a 20-hp. d.c. element operating from the auxiliary generator and a 15-hp. element operating from standby power. When operating on standby power the d.c. element functions as a generator to supply 64-volt power to the car, and the act of plugging in the a.c. power automatically causes the unloading of all four cylinders of the compressor.

The heating and air-conditioning control system is entirely automatic. The control switch has four positions; namely, "Run," "Yard," "Manual heat," and "Manual cool." Normally, the train crew has only to

Partial List of Materials and Equipment on the D. & R. G. W. Prospector Trains

Stainless steel	Allegheny-Ludlum Steel Corp., Pittsburgh, Pa.
	American Steel & Wire Company, Cleveland, Ohio.
	Carnegie-Illinois Steel Corp., Pittsburgh, Pa.
	The Eastern Rolling Mill Co., Baltimore, Md.
	Republic Steel Corp., Massillon, Ohio.
Truck frames	General Steel Castings Corp., Eddystone, Pa.
Wheel centers	American Locomotive Company, New York.
Axles	Bethlehem Steel Co., Bethlehem, Pa.

Details of the side and underframe construction of one of The Prospector cars



The floor plan of the Prospector—This two-car

The dinette, looking toward the observation-lounge

Roller bearings	The Timken Roller Bearing Co., Canton, Ohio.
Springs	American Locomotive Co., Railway Steel Spring Div., New York.
Brakes	Westinghouse Air Brake Co., Wilmerding, Pa.
Couplers	American Steel Foundries, Chicago. McConway & Torley Co., Pittsburgh, Pa.
Draft gear	W. H. Miner, Inc., Chicago.
Castings	Crucible Steel Co. of America, New York. Dodge Steel Co., Philadelphia, Pa. Treadwell Engineering Co., Easton, Pa.
Diesel engine	Hercules Motors Corp., Canton, Ohio.
Normalizers	Schwitzer-Cummins Co., Indianapolis, Ind.
Amplidyne; traction generators	General Electric Company, Schenectady, N. Y.
Radiator	Young Radiator Co., Racine, Wis.
Cooling fans	B. F. Sturtevant Co., Hyde Park, Boston, Mass.
Water pumps	Worthington Pump and Machinery Corp., Harrison, N. J.
Air compressor	Westinghouse Air Brake Co., Wilmerding, Pa.
Batteries	Electric Storage Battery Co., Philadelphia, Pa.
Insulation	Gustin-Bacon Mfg. Co., Kansas City, Mo.
Air conditioning	B. F. Sturtevant Co., Hyde Park, Boston, Mass.
Heating	The Fulton-Sylphon Co., Knoxville, Tenn.
Anemostat	Anemostat Corp. of America, New York.
Grills	Barber-Colman Company, Rockford, Ill.
Lighting	Safety Car Heating & Lighting Co., New York.
Lamps; wire	General Electric Company, Schenectady, N. Y.
Conduit	Republic Steel Corp., Massillon, Ohio.
Receptacles	The Pyle-National Company, Chicago.
Sash	Hunter Sash Co., Inc., Flushing, L. I., N. Y.
Glass	Hires-Turner Glass Co., Philadelphia, Pa. Pittsburgh Plate Glass Co., Pittsburgh, Pa. Pressed Prism Plate Glass Co., Chicago.
Roller curtains	The Pantasote Co., Inc., New York.
Curtain fixtures	The Adams & Westlake Co., Elkhart, Ind.
Carpet; upholstery; drapes	L. C. Chase & Co., Inc., New York.
Cork; linoleum	Armstrong Cork Co., Lancaster, Pa.
Kitchen equipment	Angelo Colonna, Philadelphia, Pa.
Coach seats; vanity chairs	Troy Sunshade Co., Troy, Ohio.
Lounge chairs	Heywood-Wakefield Co., Gardner, Mass.
Water cooler	Marquette Railway Supply Co., Chicago.
Lavatories	Crane Co., Chicago.
Hoppers	Duner Co., Chicago.
Pipe covering	Gustin-Bacon Mfg. Co., Kansas City, Mo.
Paint	E. I. du Pont de Nemours & Co., Wilmington, Del.

put the control switch in either the "Run" or "Yard" position.

The cooling system is controlled in two steps. When the temperature in the return-air stream drops below 74 deg. F., half of the cylinders of the compressor are made inactive by a solenoid by-pass valve and a solenoid valve closes off half of the evaporator surface. If the temperature goes below 72 deg. F., the compressor is shut down; above 74 deg. F., the compressor is running with full load.

Lighting

Fluorescent lighting in Safety fixtures is used exclusively, except for the cab and vestibules. In the coach are ceiling fixtures for general illumination and bag-rack units for reading. In the sleeping-car sections and cabinettes the 9-in., 6-watt lamp units have manual starting switches. All other lighting is accomplished with 15-in., 14-watt lamps with magnetic starters. At the front end of the train a movable spotlight supplements the headlight on curved track.

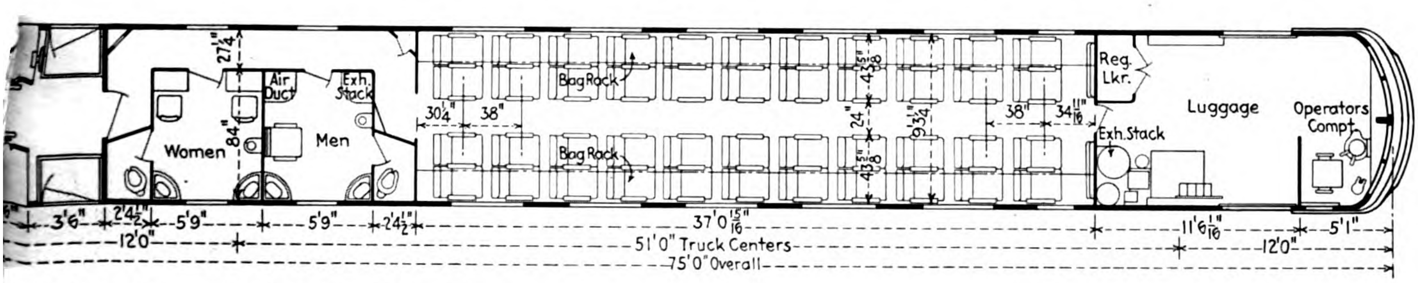
Trucks and Couplers

The four-wheel trucks are General Steel Castings single drop-equalizer type, with coil springs under the bolsters as well as between the truck frames and equalizers. Each axle is driven by a high-speed propeller-

The coach interior

type motor through bevel gears, the commutator end of the motor being suspended between the coil springs mounted in the truck transom. The wheels have cast-steel spoke centers with steel tires, 36 in. in diameter. This type of wheel was adopted because the Budd disc brake relieves the wheel rims of the temperature rise

(*Continued on page 511*)



s designed for operation in one direction only

Milwaukee Builds

Large Welded Box Cars

Five hundred 50-ton cars have exceptionally large cubic capacity and embody unique features in design—Roofs, ends and sides prefabricated and put together on assembly line

THE Chicago, Milwaukee, St. Paul & Pacific has recently completed building at the company shops, Milwaukee, Wis., five hundred 50-ton box cars which are entirely fabricated by welding and include a number of other interesting features of construction aside from being about the largest 50-ft. 6-in. box car possible to build within the A. A. R. clearance limits. The light weight of the car is 48,200 lb. and the cubic capacity, 5,157 cu. ft., the ratio of load limit to gross load, 71.5 per cent and of light weight to cubic capacity, 9.35 lb. per cu. ft.

The other features of special interest, mentioned, include the following: Leak-proof side doors, mounted in rigid steel frames which are welded as units into the car sides and give increased strength at a point where it is greatly needed; two-piece car ends and narrow adjoining side pans, also prefabricated and welded into strong structural units; car floor between the doorways protected against wear by a perforated steel plate and sealer; plywood inside lining panels 54 in. wide at the doorways readily renewable when damaged; individual floor boards which also may be renewed without disturbing the side lining; easily removable clean-out boards to permit thorough blowing out back of the lining at both sides and ends; nailing post positions inside the car indicated by vertical rows of dashes burned into every other lining board by means of an electric marker.

The 500 new 50-ton box cars have been constructed by the Milwaukee to meet the ever-increasing demand for box cars of this capacity, not equipped with automobile loading devices, but adapted for the general loading of finished lumber, wood pulp, plywood and mill products, originating primarily in the Northwest. In addition, these 50-ft. 6-in. cars are required for the loading of light, bulky commodities, such as electric refrigerators, radios, furniture, cereals, tinware and empty cans and for mixed commodities which, to prevent damage, cannot be loaded high. The all-commodity freight rate to the Pacific Coast, which prescribes a carload minimum of 30,000 lb. without regard to size of car, also causes shippers using this rate to insist upon being supplied with 50-ft. cars.

The new box-car design embodies the more or less familiar Milwaukee construction with horizontal-rib side sheet strips united by electric spot welding. The car sides, ends and posts are made of USS Cor-Ten steel, the center sill being a special composition steel supplied by the Inland Steel Company. The door pans and corner pans are pressings made of both Yoloy and Nax low-alloy high-tensile steels.

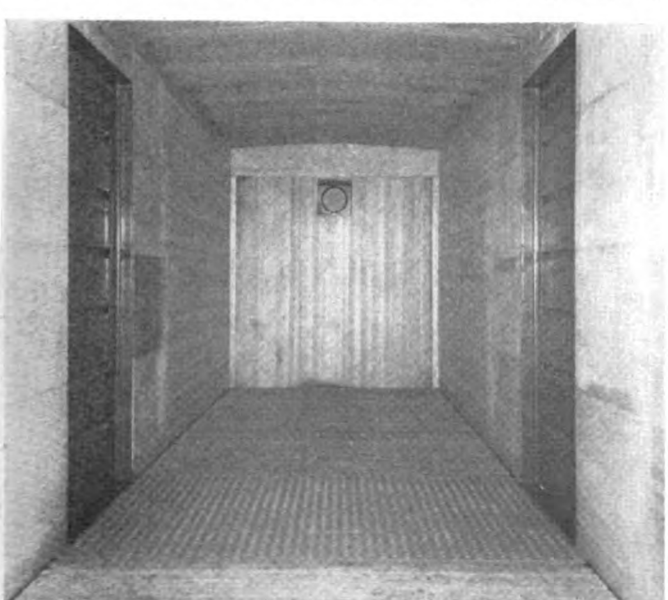
The side doors are Youngstown, and the car roofs and ends, Standard. The order for draft gears was divided

Milwaukee 50-ton box car

The car underframe and side frame construction—The prefabricated center floor section is being applied

between five manufacturers of recognized draft gears which more than meet the A. A. R. minimum requirements. The Bettendorf truck sides and bolsters are designed to incorporate the truck stabilizing device supplied by the Standard Car Truck Company. Other equipment includes Stucki side bearings, Schaefer brake hangers, Creco brake-beams and bottom-rod supports and uncoupling mechanism supplied the Standard Railway Equipment Company.

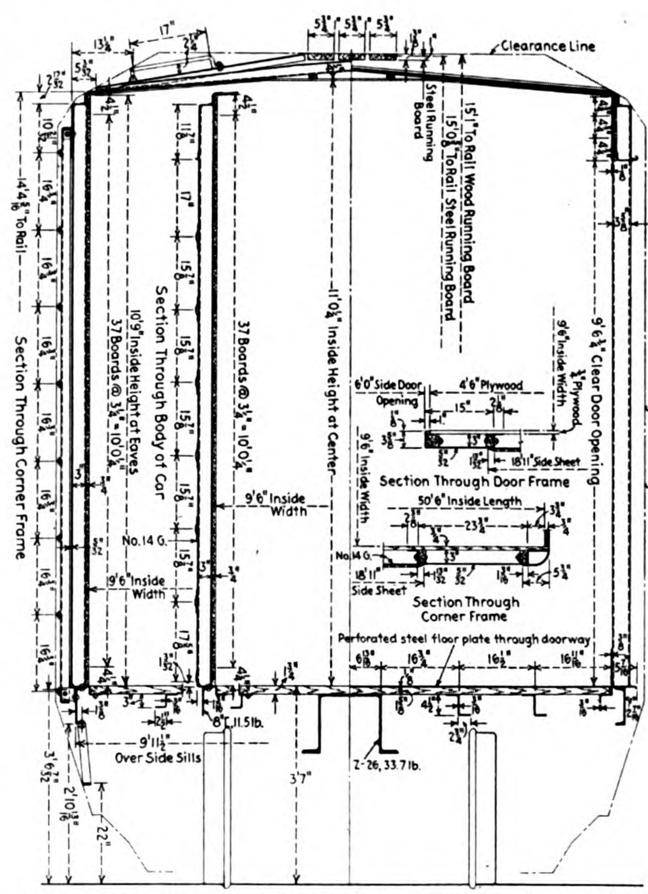
The bolster center filler and rear draft-lug casting,



Interior of the car—The prefabricated floor at the doorways is surfaced with perforated steel wear plates

General Dimensions and Weights of New Milwaukee 50-Ton Box Cars

Length over striking castings, ft.-in.	51-7⅝
Inside length, ft.-in.	50-6
Inside width, ft.-in.	9-6
Inside height at center, ft.-in.	11-¼
Inside height at eaves, ft.-in.	10-9
Distance between truck centers, ft.-in.	40-7⅝
Width over side sheets, ft.-in.	10-1⅝
Width over side plates, ft.-in.	10-1 13/16
Width over roof sheets, ft.-in.	9-8¼
Width over side sills, ft.-in.	9-11½
Height—top of rail to top of floor, ft.-in.	**3-7**
Height—top of rail to running board—steel, ft.-in.	15-⅝
Height—top of rail to eaves, ft.-in.	14-4 5/16
Width over door locks—Camel door, ft.-in.	10-8
Side door opening, ft.-in.	9-6¾ high by 6-0 wide
End door opening A end, in.	16 high by 18½ wide
Width over side ladders, ft.-in.	10-7⅜
Light weight, lb.	48,200
Load limit, lb.	120,800
Capacity, cu. ft.	5,157
Ratio load limit to gross load, per cent	71.5
Ratio light weight to cubic capacity, lb. per cu. ft.	9.35



Cross-sections and sectional details of the Milwaukee 50-ton box car

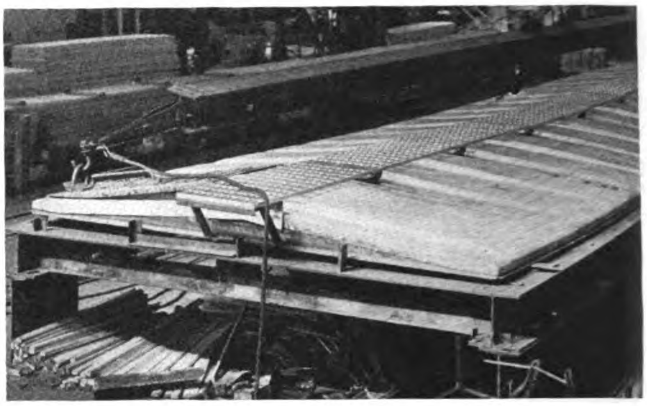
which is another feature of the design of this car, is also supplied by the Bettendorf Company which furnishes the lumber door. The order for couplers and yokes was divided between Buckeye and Gould. The air brake equipment is Type AB built by Westinghouse. The hand brakes are Equipco and Universal types. The car wheels are cast iron, manufactured at the Milwaukee foundry. Plywood for the ceiling and top end pieces was supplied by the Harbor Plywood Corporation. Side and end lining and the floor boards are of Douglas fir. The defect-card holder is the Railway Products Company's design.

How the Increased Capacity Is Secured

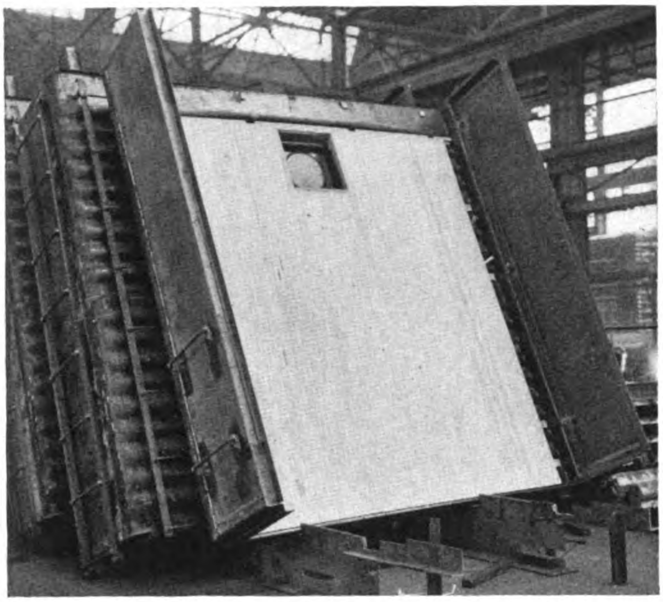
Referring to the table of dimensions, it will be noted that the limiting width in this car, as in practically all box cars, is the distance over door roller housings. The increased capacity in this instance is secured primarily by revising the side door and door fixture construction so as to permit designing the car 4 in. wider on the

inside than is the case with the A. A. R. standard car. The rollers in this design are placed underneath the door and the Camel door fixtures and operating mechanism are redesigned for a minimum projection beyond the outer door surface. The outer surfaces of the side sheets also are spaced so as to bring the width over sides ladders just within the required limit.

The capacity of the car is also increased by raising the car roof as high as practicable to give an inside height at the eaves of 10 ft. 9 in. and at the center of 11 ft. ¼ in. Referring to the drawing, it will be observed how both the roof and side construction are designed to fit just within the A. A. R. clearance lines. Increased roof height is made possible by the use of a $\frac{3}{16}$-in. Safety



How the car roof and running board are pre-assembled



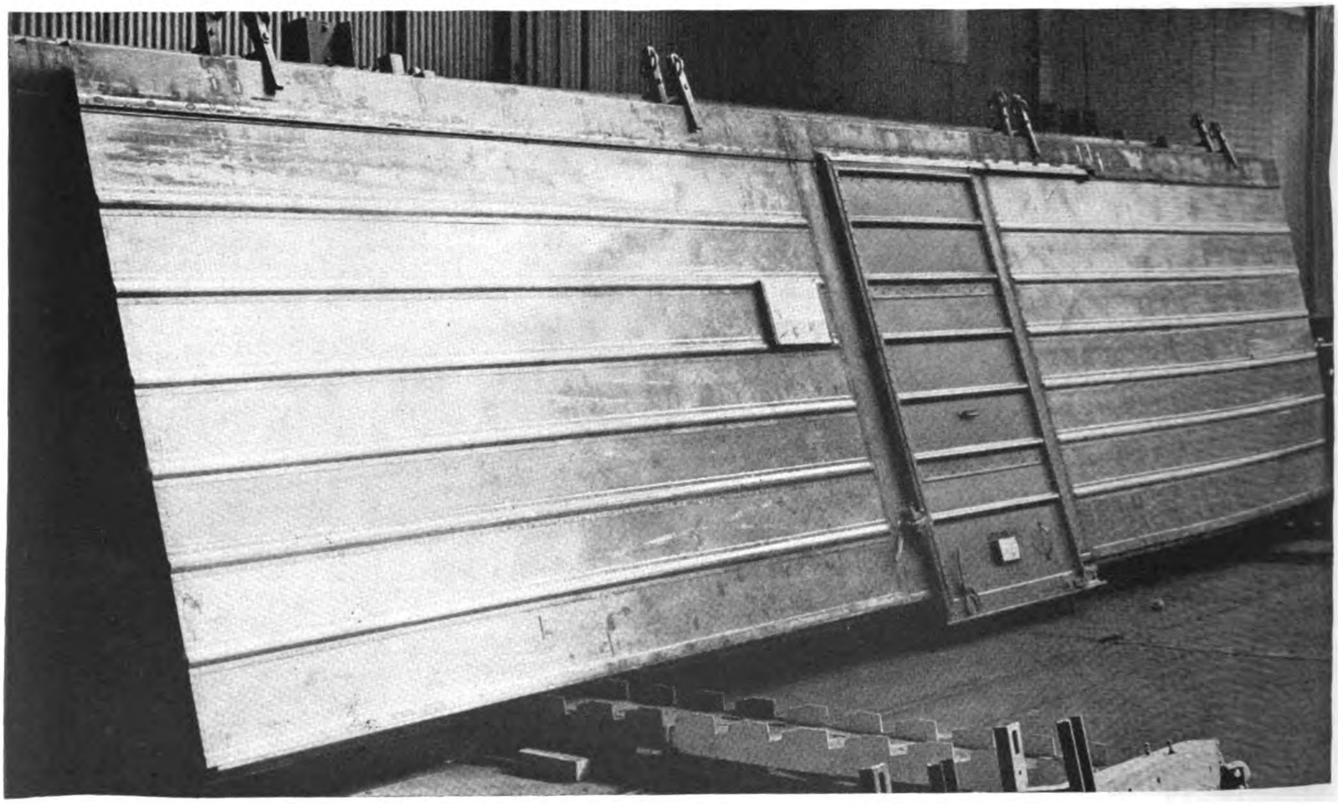
Unit car ends completed and ready to fit into the car structure

steel tread plate instead of the conventional running board, and applying the lateral running board with only ¼ in. clearance between the roof sheet and the bottom of the running board, flanged edges being placed in the lower connection of the roof for stiffness.

General Method of Assembling the Car Structures

The new Milwaukee box cars were turned out of the shop at the rate of seven cars a day, the assembly line making one move every 68 min. The principal electric welding machines used in building this type of car include a large hydromatic spot welder, a pedestal spot welder, a series welder, and numerous machines with leads for individual welding operators. Underframes, sides, ends, rooms, etc., are fabricated as units.

In the construction of the underframe, for example, the center and side sills are delivered to the erecting shop and necessary punching done on the spacing machine adjacent to the underframe jig. The center-sill sections are assembled in the jig together with the combined cen-

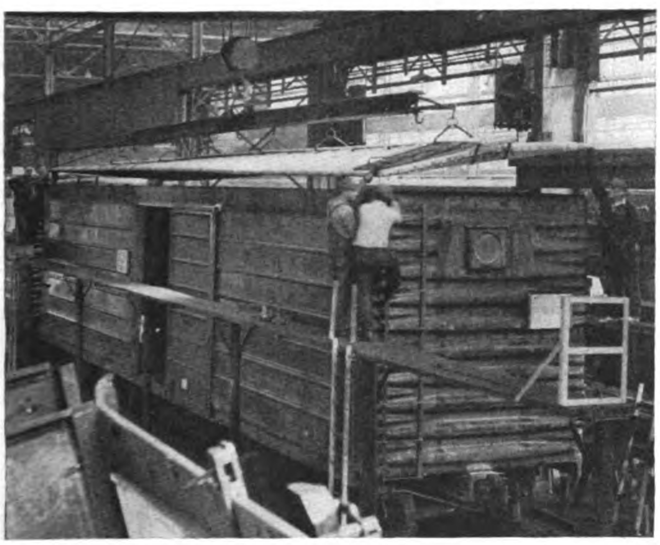


Assembled car sides ready for application to the underframe

ter filler and rear-draft-lug casting, also the striking casting, these parts being welded together by the electric process. The side sills, bolsters and cross bearers are applied in the jig and the entire underframe welded together at the first underframe position. At the second position, the underframe is turned upside down for finish welding and the application of couplers and draft gears, air-brake equipment including levers, rods and pipes, etc.

Each side section, approximately 19 ft. long by 10½ ft. high, is assembled under a series welder and tack welded. It is then moved to the hydromatic welder for completion of the electric-spot welding operation. The door frame, 8 ft. 9 in. high by 10½ ft. wide, consists of door pans, threshold and side plate, rigidly welded together and including a pre-assembled door with all door fixtures applied. Two side sections and the door frame are then assembled in a jig to form a single car side and completely welded from the inside, then being turned over for completion of the exterior welding.

The car ends are assembled in a stationary jig, the two sections of each end being butt-welded together and the brake step and hand brake riveted on the upper section.



Putting on the car roof after the sides and ends have been assembled

The pre-fabricated lumber door and end ladders also are applied. The end is then turned over on the jig so that corner pans with the upper elements and auxiliary side sill can be welded in place. The wood filler pieces, the end lining, the grab-irons and side ladder are applied.

The roof is constructed in a special jig, in which the individual sheets are drawn together to the exact length desired and welded in place. The prefabricated running board is applied in this position. The roof is then turned over on an adjacent jig and wood fillers and plywood ceiling panels put in place; the former are held by bolts and the latter with screws. The 8-ft. section of car floor at the doorway, protected by steel plate, is also prefabricated by assembling four pieces of the steel plate, perforated with 2-in. round holes, in a jig where they are welded together, applied over the wood flooring and bolted in place.

At No. 1 erecting position, the car sides, doorway floor plate, ends and roof are set in position on the underframe which rests on its own trucks. The car then moves to No. 2 position where it is squared up and tacked together by electric welding. In this position the doorway floor plate is welded to the threshold plate and auxiliary side plate by continuous weld, thereby accurately fixing the inside width of the car, squaring up the car permanently, and, by tying the two side sills together, a girder is formed which strengthens the car at its weakest point. At positions 3 and 4, the car is completely welded.

The car then moves outside the shop to the spray booth where the underframe and inside are primed.

On returning to the shop at the wood track, the rest of the car floor is laid and bolted. The nailing posts and door plywood panels are applied, the latter being made just wide enough so that two 19 ft. lengths of tongue-and-groove lumber will complete the side lining. The side lining includes lower and upper clean-out boards and is toe-nailed so that no nail heads are exposed to work out. The end lining includes side clean-out boards and a top plywood piece.

A special moisture-proof floor sealer is applied over the steel wear plate at the car doors and the joint between the car sides and ends and the floor are also effectively sealed against the entrance of moisture at this critical point. The air brakes are tested and the car stenciled.

D. & R. G. W. Prospector Trains

(*Continued from page 507*)

caused by rim braking. On all axle journals are Timken roller bearings.

The truck brakes are the Budd disc type. Double cast-iron discs are mounted on the inside hub of each wheel; the inner and outer faces of the discs are separated by radial vanes which act as impellers for the dissipation of the heat generated in braking. Brake shoes are of composition lining, one on each side of the disc and covering approximately one-fourth of the circumference. These shoes are operated by a pair of tongs fulcrumed on a support lying just outside of the disc radius. The outer extremities of the tongs are coupled to the piston in an air cylinder. The coefficient of friction between the brake shoes and the cast-iron discs is said to be practically constant through a wide range of application pressures, temperatures, speed, and sequence of application. Deceleration is, therefore, approximately uniform from the beginning of the application until the train stops. The emergency deceleration rate on The Prospectors is set at about 3.3 miles per hour per second.

The brake cylinders are attached by bolting flanges to the sides of the motor case, and the torque reaction is taken through the motor suspension springs.

The air brakes are the Westinghouse H.S.C. system with electro-pneumatic control and decelostat wheel-slip control. Air is supplied by two Westinghouse DH-25 motor-driven compressors located in the baggage room of the front car. Sanding equipment is applied on each truck and is operated manually by the engineman or automatically in emergency and when the decelostat relays operate.

The car bodies differ in some respects from the customary Budd type of structure. Strain-gage measurements indicate that they can withstand 400,000 lb. end compression, including a safety factor of two, which is adequate to permit a total train weight of 600,000 lb.—approximately double the normal two-car train consist. The sides below the window sill are corrugated plate girders. The corrugations, similar in form to those on the roof, are spot welded to the vertical frame members. The structure above the belt rail is the truss type.

The couplers between the cars are the American Steel Foundries controlled-slack type and are fitted with special Miner draft gears designed for these trains. McConway & Torley retractable couplers are installed at the front and rear ends of the trains.

A. A. R. To Limit

Car Types During Emergency

A. A. R. asks members approval of commitment to O. P. M. restricting orders to 13 box, open-top, and flat-car designs recommended by the Car Construction Committee

In the belief that the successful completion of the railroad program to own 1,800,000 freight cars by October, 1942, is contingent upon affirmative action by the O. P. M. to obtain the required material, the member roads of the Association of American Railroads have been asked by J. J. Pelley, president, in a letter dated November 5, to authorize the officers of the association to state to the O. P. M. that during the emergency future orders for new box, open-top, and flat cars will conform to 13 designs. These were recommended in a report of the Car Construction Committee of the Mechanical Division. The 13 designs comprise three box cars, one auto-box car, two hopper cars, four gondola cars, and three flat cars. In his letter Mr. Pelley points out that by thus restricting the number of designs of new equipment O. P. M. expects to increase the capacity of car-building facilities and to simplify the material supply problems. "As the matter now stands," he said, "procurement of material for new freight cars is contingent on acceptance by the railroads of some program of simplified practice and a firm commitment to that effect to the O. P. M."

In recommending these designs, it is the thought of the Car Construction Committee and the General Committee of the Mechanical Division that cars built during the present emergency should be of such dimensions as will freely interchange over all main lines. Should there be need for cars of special dimensions for handling special shipments or should there be need of other types of cars for special commodities, the individual railroads originating such traffic should provide the equipment for it either by altering existing cars or by providing new cars to the required dimensions or of the required type only in such quantity as are required to handle the special traffic.

The designs proposed by the Car Construction Committee are as follows:

Box Cars

The first of the box cars is the A. A. R. 40-ft. 6-in. car with an inside height at the eaves of 10 ft. The inside width is 9 ft. 2 in. and the clear door opening 6 ft. This car is built for both 40- and 50-ton nominal capacities. Designs are shown in A. A. R. Supplement to the Manual of the Mechanical Division (1500 Series of plates). All car builders have available designs, dies, patterns, etc., and are fully equipped to build these cars.

With the exception of a 6-in. increase in height, which involves the lengthening of side sheets, end sheets, door posts, corner posts, side posts, side doors, etc., the second box car is identical with the A. A. R. car with 10 ft. inside height, for which all car builders have designs. These designs can be readily modified to suit the 10-ft. 6-in. inside height and no additional dies or patterns are required. Cars to these dimensions have been built by the Pressed Steel Car Company, to their drawing 65885-D, for the Chicago, Rock Island & Pacific, and are being built by the American Car and Foundry Company for the Missouri Pacific.

The third box car design recommended by the committee is for a 50-ton car with an inside length of 50 ft. 6 in., an inside width of 9 ft. 2 in., an inside height at eaves of 10 ft. 6 in., and a clear door opening of 8 ft. All car builders are said to have dies and patterns for these cars which are the same as for the A. A. R. 40-ft. 6-in. car with 10 ft. inside height. The proposed general design drawing has been completed under the supervision of the Committee on Car Construction.

The proposed auto-box car design is of the same general dimensions as the 50-ft. 6-in. box car, except for a clear door opening of 15 ft. The design of the underframe for the two 50-ft. 6-in. box cars will be the same with the exception that the auto-box car will have additional reinforcement at the 15-ft. double side doors. Dies for the main cross-bearers and cross-ties will also be different. The proposed general design drawing of this car has been completed under the supervision of the Car Construction Committee. Provision is made in one end for double end doors as an alternate. This car is suitable for the application of loading devices.

Hopper Cars

Designs for the 50- and 70-ton cars are shown in the A. A. R. Supplement to the Manual of the Mechanical Division (600 Series of plates, built-up riveted construction) and many thousands of them have been built. The committee reports that all car builders have available designs, dies, and patterns and are fully equipped to build these cars.

Gondola Cars

No A. A. R. gondola-car designs have been developed. The Car Construction Committee reports that this is chiefly due to differences in service requirements in the various sections of the country. The eastern roads use solid-bottom gondola cars, principally for steel-mill products and to a lesser extent for coal, sand, etc. The western roads use general service gondola cars for coal, gravel, road-building material, etc., many of which are equipped with dumping arrangements. Based on a review of designs built during recent years, the committee has selected the following types as most suitable for these requirements:

Gondola Car—Fixed End—This is a car, the designs, dies, and patterns for which are available at the Bethlehem Steel Company, in both wood and steel floor construction (Drawing C-27252-C and Drawing C-28263A, respectively) having steel sides. These 50-ton cars, which have been built for the Atlantic Coast Line, have

(*Continued on page 515*)

Boiler Makers' Association Report on the

Effect of High Temperatures

By Ray McBrian*

THIS is a progress report on the studies of the effect of aging properties and effect at elevated temperatures and surface decarburization. In addition to the damping capacity tests for aging there is now under construction an X-ray diffraction unit for the study of internal stresses and the identification of complex compounds occurring in microscopic cracks. By the use of this equipment it is hoped to secure some knowledge as to the mechanism of the various types of cracking associated with firebox and boiler problems.

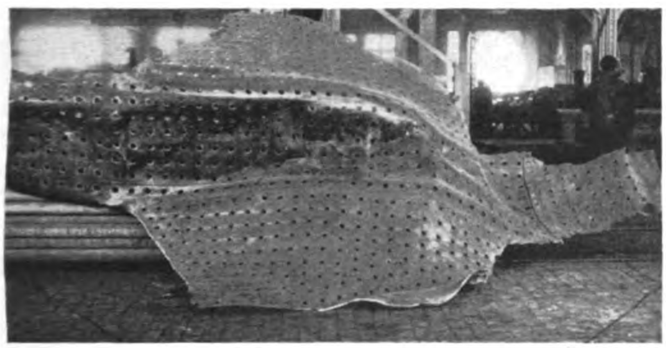


Fig. 1—Portions of the firebox sheets showing discoloration from excessive temperature

In spite of the interest that has been manifested failures continue to occur and on our own road we are trying to correlate the study of service failures with research. For example, our unfortunate explosion of passenger locomotive No. 1804 brought out forcibly the added factor of safety which would be available by the use of materials with higher strength at elevated temperatures.

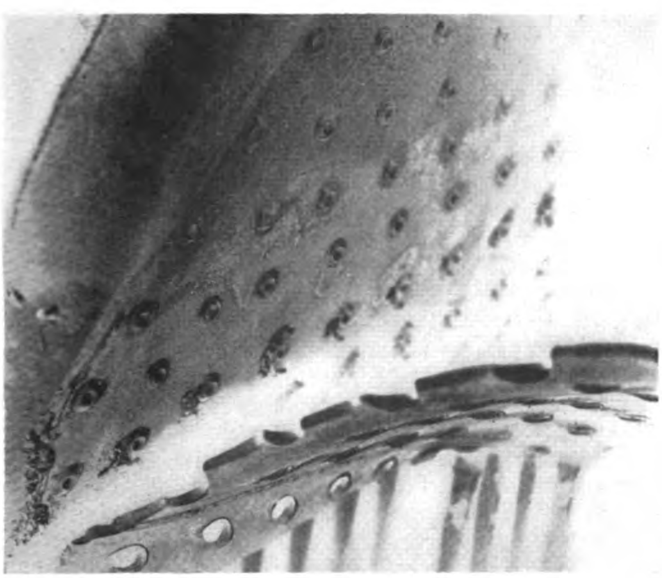


Fig. 2—The syphon and a portion of the crown sheet at point of rupture

A novel feature of this investigation was the use of color photography. Fig. 1 shows portions of the crown sheet, door, and sides of firebox syphons. It will be noted that the syphons display a normal steely color; the crown sheet and portion of the door show the discoloration from overheating. The origin of the failure was at a point adjacent to the combustion-chamber syphon and the highest point of the crown sheet. [Note: While the author's original slides were in color, which is not reproduced here, the conditions he emphasizes are discernible in these illustrations.—EDITOR.]

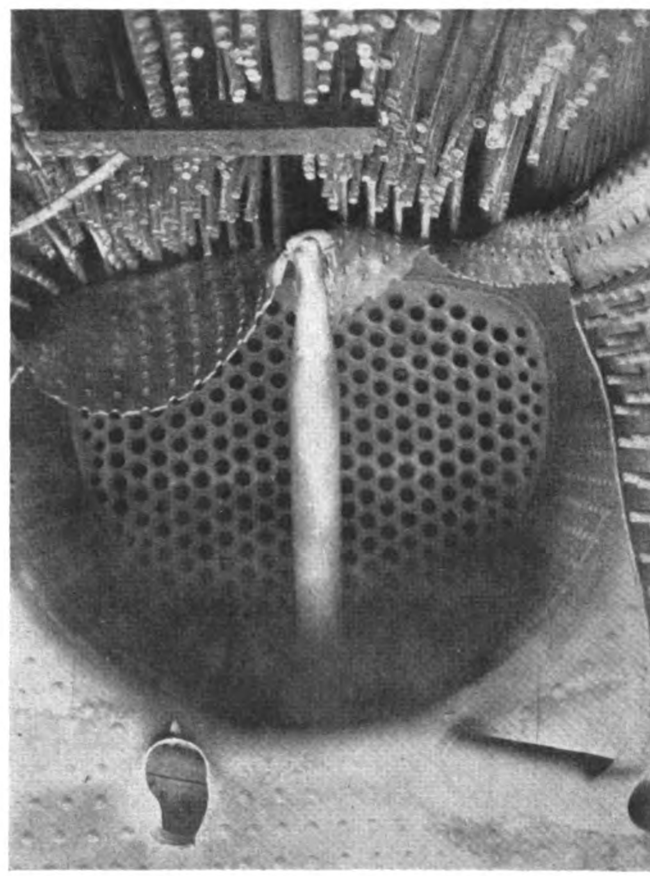


Fig. 3—The condition of the interior of the firebox is shown here

Fig. 2 shows the combustion syphon and portion of the crown sheet at the point of rupture. The reduction of area around the staybolt holes and the horizontal color line coincident with the fourth row of syphon stays may readily be seen.

Fig. 3 is a photograph taken inside the firebox showing the combustion-chamber syphon, the back flue sheet, and the same portion of the crown sheet as that shown in Fig. 2. The discoloration shows down to the eighth row of flues indicating the extreme low-water condition at the time of the explosion. From the color line in the fire-

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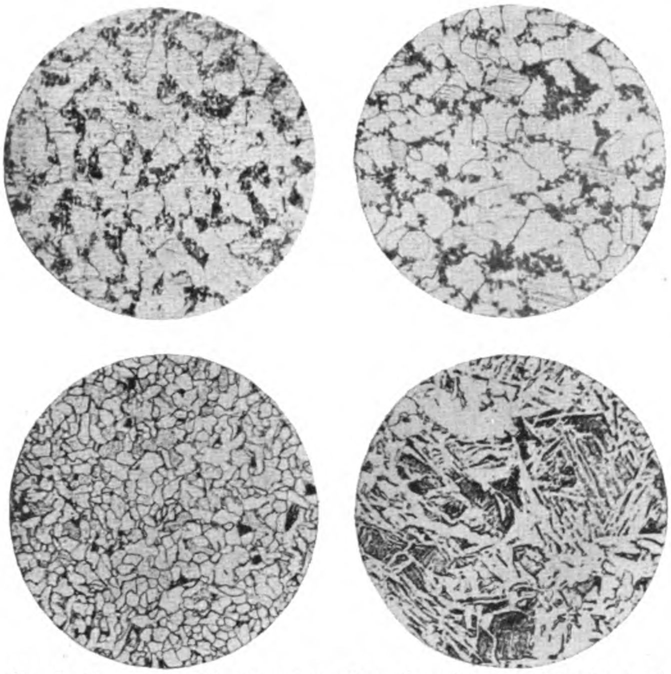


Fig. 4—Upper left: Microstructure of portion of crown sheet involved in the explosion when heated to 1,350 deg. F.—Upper right: A comparative piece of crown sheet heated to the same temperature—Lower left: A piece of the same sheet heated to 1,650 deg.—Lower right: Another piece of the same sheet heated to 1,800 deg. F.

box and from the boiler dimension it has been calculated that the water level at the time of the explosion was at least 2,750 gal. below the bottom of the gage glass. Of passing interest it will be noted that the combustion-chamber syphon adds considerable structural stiffness to the crown sheet as shown in the manner in which the crown sheet sagged on both sides of the syphon.

Color pictures made it possible to show conditions in this firebox after the explosion which could not have been shown by the use of black-and-white photography.

The photographs show that the primary cause of this explosion was overheating from low water. Metallurgical examination and study indicates that by the use of a material with greater strength at elevated temperatures this failure might have been prevented.

The microstructures found at various locations around the firebox showed that maximum temperature was reached at a point coincident with the origin of the explosion and established the maximum temperature as between 1,350 deg. and 1,400 deg. F.

Fig. 4 shows the microstructure of a portion of the crown sheet which had been heated to this temperature. For comparison, pieces of the crown sheet were heated to 1,350 deg. F., 1,650 deg. F., and to 1,800 deg. F.

The effect on the microstructure of heating to these different temperatures, is shown and by comparison with these photographs the temperature to which the crown sheet had been heated was determined. The structure obtained by heating to 1,350 deg. F. was almost identical to that shown in the crown-sheet sample. All of the micrographs were made at 200 diameters.

To determine the strength of the crown sheet at the temperature at which it failed, tensile tests were made at 1,385 deg. F. Tensile tests were also made of carbon-molybdenum fire-box steel at this same temperature, for comparison. The molybdenum content of the firebox steel was taken at this same temperature, for comparison. It was one-half of one per cent.

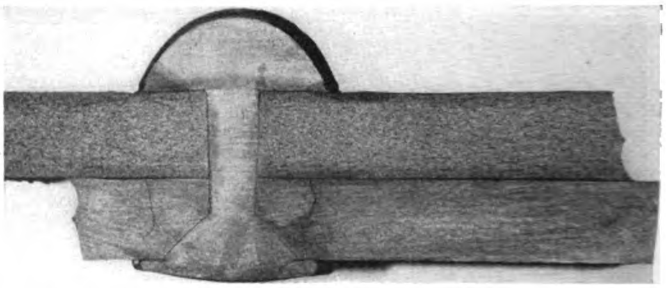


Fig. 6—An etched cross-section of a riveted seam showing the sharp edges in the rivet hole

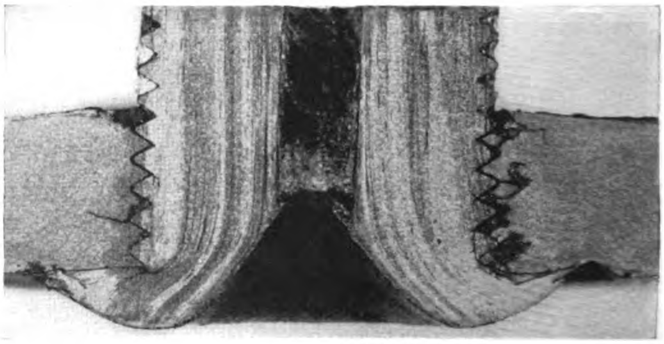


Fig. 7—Section of sheet at the root of the thread showing a crack originating in the interior of the sheet

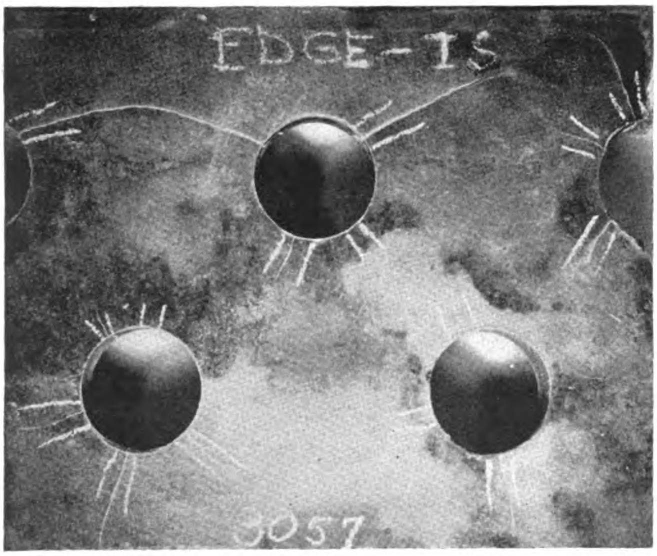


Fig. 5—Cracks in a boiler seam as indicated by Magnaflux testing

The results of these tests indicated that the tensile strength of the crown sheet where it failed was approximately 5,600 lb. per sq. in., or only one-ninth the value at room temperature. The carbon-molybdenum firebox steel at this temperature had a tensile strength of 13,400 lb. per. sq. in. or more than double the strength of plain carbon steel. To demonstrate that the reduction in strength due to overheating alone could cause the failure of this firebox, the following calculations were made:

Using the formula $$S = \frac{Pa^2}{4\,T^2}$$

Where S = maximum working fibre stress, lb. per sq. in.
P = boiler pressure, lb. per sq. in.
a = staybolt pitch, in.
T = thickness of plate, in.

A $\frac{3}{8}$-in. plate and a staybolt pitch of 4 in. give a working stress of about 8,000 lb. per sq. in. for 280 lb. boiler pressure.

From the elevated temperature tests it was shown that for the plain carbon steel the strength at 1,385 deg. F. was only 5,600 lb. per sq. in. or 2,400 lb. per sq. in. lower than the working stress at that temperature. It was found then that the boiler pressure alone was sufficient to cause a failure when the temperature of the crown sheet approaches 1,350 deg. F. Also, it was found that the molybdenum steel, due to its higher strength at elevated temperatures, would not have failed at this working stress at 1,385 deg. F.

The results of this investigation emphasize the necessity for recognizing the importance of the elevated-temperature strength properties of boiler and firebox materials.

The importance of fabrication practices is further demonstrated as shown by the failure illustrated in Fig. 5 which shows cracks in a section of a boiler-shell seam. These cracks are outlined with Magnaflux powder and indicated by white lines. The micrographs showed these cracks to be trans-crystalline, and this brings out the important point of properly identifying failures.

It was found that these cracks originated at the sharp edges of the holes. Some had referred to them as embrittlement cracks; the micrographs show they were trans-crystalline. This brings out the need for recognizing the importance of removing all sharp edges from riveted seams.

Fig. 6 is an etched cross section of a riveted seam showing the sharp corners in the rivet hole and the deformation of the plate from high caulking pressure. This practice helps to provide the conditions necessary to get failures from stress concentrations which can develop intergranularly.

Fig. 7 is of a section of firebox side sheet and staybolt, showing a crack originating in the interior of the sheet at the root of a thread where the stress is concentrated at a sharp corner. This etched section again demonstrates the need for understanding the elevated temperature properties of both the side sheet and staybolt materials. The side sheet was corrugated, indicating lack of the necessary strength under load at operating pressure and temperature. The effect of corrugation is to cause the threads to engage mostly on the fire side of the sheet. In consequence of such action the staybolt bears all its load at the last few threads. Since the head of the bolt is at a relatively higher temperature, the net effect especially with the ordinary iron or steel bolts, is that the bolt is much weaker, due to its loss of strength from temperature effects.

We have found that by the use of such an alloying element as molybdenum, we can secure an iron or steel alloy with increased strength at elevated temperature.

To Limit Car Types During Emergency

(*Continued from page 512*)

an inside length of 41 ft. 6 in., an inside width of 9 ft. 6 in., and an inside height of 4 ft. 8 in.

Gondola Car—Fixed Ends, with Drop Bottom—The designs, dies, and patterns for this 50-ton car are available at the General American Transportation Corporation (their drawings 5-1595 and 4-3599), and were built for the Illinois Central. They have an inside length of 41 ft., an inside width of 9 ft. 6 in., an inside height of 5 ft., and have 16 drop doors in the floor.

Gondola Car—Drop Ends—Designs, dies, and patterns for these cars are available at the Bethlehem Steel Company to their drawings C-27425-C. They are 70-ton cars and were built for the Lehigh Valley. They have an inside length of 52 ft. 6 in., an inside width of 9 ft. 6 in., and an inside height of 3 ft. 6 in. The floors are wood.

Mill Type Gondola—Drop Ends—This is a car, the design, dies, and pattern for which are available at the General American Transportation Corporation to their drawing 5-1608. These cars, which were built for the Atchison, Topeka & Santa Fe, have a nominal capacity of 70 tons, an inside length of 65 ft. 6 in., an inside width of 7 ft. 9 in., and an inside height of 3 ft. 6 in. These cars have steel floors.

Flat Cars

No designs of flat cars have been developed by the A. A. R. The designs which follow were selected by the committee after reviewing cars built during recent years.

The first is a 50-ton car, designs, dies and patterns for which are available at the Pullman-Standard Car Manufacturing Company to their drawing 509-F-63-I. These cars were built for the Union Pacific. The length over the floor is 53 ft. 6 in., the width over the floor, 10 ft. 6 in., and the height, rail to top of floor, 3 ft. 7¼ in. They have a wood floor.

The second design recommended by the committee is for a 70-ton car the designs of which are available at the Greenville Steel Car Company to their drawing 16393. They were built for the Erie and have a length of 53 ft. 6 in. over the floor, a width of 10 ft. 6 in. over the floor, and a height, top of rail to floor, of 3 ft. 5 in. The floor is of wood.

The third flat-car design recommended by the committee is a 70-ton car built on a cast-steel underframe, the patterns for which are available at the plant of the General Steel Castings Corporation, Granite City, Ill. The cars were built to Pennsylvania Railroad drawing A402605C. The length over strikers is 50 ft., the width over the floor 9 ft. 3 in., and the height rail to top of floor, 3 ft. 5⅛ in. The cars have a wood floor.

The report of the Car Construction Committee, to which general arrangement drawings are attached, concludes as follows: "The foregoing recommendations have been submitted to the car builders who advise that the designs recommended do not present any difficulties in the matter of dies which they may be called upon to make in the event of the purchase of any of these cars. This has particular reference to the gondola car and flat cars as the car builders are now in possession of all dies for the box and hopper cars recommended and can without much difficulty prepare dies for the auto-box cars recommended. The car builders mentioned as having available designs, patterns, etc., for gondola and flat cars have all expressed their willingness to supply to other car builders the necessary drawings so that they may construct cars to these same designs."

Small But Busy Private Railroads are being operated by the Army's Quartermaster Corps in 168 posts, camps and stations, according to the War Department. These operations involve 140 locomotives, 89 locomotive cranes, 1,481 cars operating over 563 mi. of track. Of the total trackage approximately 497 mi. is standard gage, 52 mi. narrow gage and 14 mi. 5 ft. gage [the latter presumably refers to Army trackage in the Canal Zone which is so gaged to connect with the tracks of the Panama railroad]. The equipment of these railroads ranges from tiny narrow-gage locomotives to the 100-ton Diesel-electric switcher at Camp Blanding, Fla., which handles a standard freight train of 75 to 80 loaded cars.

Measurement of

Stresses in Car Wheels

Part I†

By Reid L. Kenyon and Harry Tobin*

Application of a method for studying stresses in structures to the study of stresses in car wheels as used in the research laboratories of the American Rolling Mill Company

STATIC loading tests have always shown wrought steel wheels to have a large excess of strength to resist rupture but the effect of variations in manufacturing processes and of conditions of service under railway cars could not be thoroughly investigated by static loading tests. During recent years the railroads have stepped up the entire tempo of their operations and there has been an increasing need for a quantitative method for measuring the stresses in car wheels.

Service conditions previously were not severe enough to raise any question as to whether the wheels were adequate as to strength and design but the advent of higher speed trains and the need for weight reduction has served as an impetus to the development of quantitative methods for stress measurement in wheels.

The method described in this paper is basically that used by the National Bureau of Standards [1], [2], [3], [4] for studying stresses in bridges, airplanes and other structures. The authors have applied the method to the study of stresses in car wheels, and during its use in the Research Laboratories of The American Rolling Mill Company over a period of about six years, some modifications have been made in the previously published methods which greatly reduce the labor of computation, and also increase the accuracy of the results in calculating the stresses in any direction, based upon the actual measurements.

In the early stages of this development, it was necessary to make the computations by a graphical method such as the one described by Osgood and Sturm.[3] This was a slow method at best, although with experience, two men working together on computing and drawing could solve a rosette in 20 minutes. Later, a trigonometric solution of the graphical method was developed which reduced the time to 10 minutes for only one man. Next came graphical charts, modified from those described by Stang and Greenspan,[2] which reduced the time to about 5 minutes per rosette. The slide rule developed by the authors now makes it possible for a single operator to compute rosettes at rate of about one a minute.

The adoption of a proper technique is highly essential to accuracy and a full description is given of that which has been developed in this laboratory.

Although the general theory is discussed in numerous texts on mechanics and the mathematical theory of elasticity, the special cases involved in this method are usually presented separately and it is assumed that the reader is fully familiar with the application of the theory to these special cases. Usually this results either in an incomplete understanding of the subject or at the least requires the assumption by the reader that the theory is probably correctly applied and he should take the correctness of the deductions for granted. As far as the authors are aware, this is the first complete discussion in one paper of the theory and the working details for measurements of internal stresses by the "rosette" or "dyadic circle" method.

The purpose of the authors in preparing such a complete presentation was to bring together in readable form the entire story of this method—its theory, and its technique.

The requirements for a satisfactory method of determining stress may be divided into those of a practical and those of a theoretical nature. It is of practical importance that the method should be accurate and reproducible, should be non-destructive so that it can be used to study the effect of service conditions and be easily and quickly applicable to the wheels to be studied, either in the laboratory, in the plant or in railroad service. From the theoretical standpoint the method should be quantitative rather than qualitative, it should determine the combined stresses and the maximum stress, and it should determine the stresses at selected positions rather than give integrated results over the entire wheel.

The methods that have previously been employed include cutting the wheel into concentric rings or making a radial cut from hub to rim or combinations of these two. Differences between measurements made before and after cutting are taken as indications of the internal stresses in the wheel. Obviously, none of these methods meets the most important of the requirements that have been mentioned; first of all they require the destruction of the wheel as a complete structure, they do not indicate the stress at selected points but "average" the stresses over large areas and finally they are not quantitative. None of these previous methods can be used to measure successive increments of stress change due to service or other imposed conditions, and none of them gives the results of the combined stresses which are acting in dif-

* Associate director and research engineer, respectively, Research Laboratories, The American Rolling Mill Company, Middletown, Ohio.

† Part II of this study will appear in a subsequent issue and will cover the practical application of this method of analysis which is developed theoretically in Part I.

[1] W. R. Osgood, Determination of Principal Stresses from strains on Four Intersecting Gage Lines 45-deg. Apart, Bureau of Standards Journal of Research, Vol. 15, Dec., 1935, R. P. 851.

[2] Ambrose H. Stang and Martin Greenspan, Graphical Computation of Stresses from Strain Data, Bureau of Standards Journal of Research, Vol. 19, Oct., 1937, R. P. 1034.

[3] W. R. Osgood and Rolland G. Sturm, Determination of Stresses from Strains on Three Intersecting Lines and its Application to Actual Tests. Bureau of Standards Journal of Research, Vol. 10, May, 1933, R. P. 559.

[4] A. H. Stang, M. Greenspan, and W. R. Osgood, Strength of a Riveted Frame Having a Curved Inner Flange. Bureau of Standards Journal of Research, Vol. 21, Dec., 1938, R. P. 853.

ferent parts of the wheel (maximum stress and its direction). The radial cut from rim to hub relieves some of the internal stress but not all due to the rigidity of the wheel section, and in any event it cannot separate the plate, hub, and rim stresses. Measurements across the radial gap in concentric rings are misleading due to bending stresses which may result from stress gradients from inside to outside circumference of the rings. This condition has been observed and is illustrated by the results of a test described in the Appendix.

Development of Method of Determining Stresses

The development to be described consists, for the most part, in the application of certain principles of the mathematical theory of elasticity with modifications to fit the particular problem in hand. For the benefit of the engineers and metallurgists who are in a position to apply the method to a study of stresses in wheels, we will present not only the practical points in the technique but also the underlying principle based on the above theory.

This theory teaches that:

1.—In a simple rod subject to uni-directional stress (longitudinal tension) a strain measurement in a single direction (longitudinal) will adequately determine the magnitude of the applied stress. Although this applied stress produces the greatest strain in the longitudinal direction, there is a definite magnitude of strain in every direction.

2.—The lateral movement caused by this longitudinally applied stress is usually expressed as a ratio of the lateral to the longitudinal strain. (Poisson's Ratio.)

3.—If a body is subject to the application of multi-directional stresses the effect of each one can be calculated separately from strain measurements made in the direction of the corresponding applied stress but the net effect of the simultaneous applications of several stresses can be determined only by the Theory of Combined Stresses.

4.—The Mathematical Theory of Elasticity furnishes a basis for the determination of stresses in any direction at a point in a body provided that suitable strain measurements can be made in three mutually perpendicular planes through this point.

5.—This usually involves experimental difficulties but it is often sufficient to determine the stress in all directions in a single plane through the body (frequently one external surface). This is quite satisfactory when the applied stresses are in this plane and when the maximum strain will be in the plane of the applied stresses.

6.—The condition just referred to is known as "plane stress" in which all applied stresses are parallel to the surface upon which the strain measurements are made. The assumption that this condition is fulfilled, which seems quite justified in the cases to be discussed, simplifies the problem by limiting it to only two dimensions.

7.—When the condition of stress at a point is fully determined it is found that there is one direction in which the stress is maximum, in the algebraic sense, and that it is minimum, in the algebraic sense, in a direction at right angles thereto. These are known as the principal stresses.

8.—The principal stresses fully determine the state of stress in all directions at that point in the body and these principal stresses, in turn, can be determined from strain readings made on three or more co-planar gage lines which intersect at this point.

The application of these principles from the Theory of Elasticity makes it possible to meet all the theoretical requirements for a satisfactory method of determining stresses. It gives quantitative values of stress at selected positions corrected for the effect of simultaneously-acting combined stresses and it should be possible to apply it non-destructively. It will be shown later that the practical requirements are also met.

The pattern of three or more intersecting gage lines has been generally described as a "rosette" and this has given rise to the term "Rosette Method" to describe this procedure for determining the condition of stress at a point in a plane when subjected to plane stress.

Theory Underlying the Rosette Method

In the following presentation one purpose has been to develop the theory underlying the rosette method but the main objective has been to work out modifications of the usual equations that would increase the accuracy of the results and at the same time result in greater ease of computation.

In developing these equations it is necessary to consider the fundamental concepts of stress and strain in an elastic body. It should be remembered in all of the following discussion that all deformations are limited to the elastic range. The expressions for strain will be developed first.

When a body is subjected to external forces it undergoes a certain amount of deformation which in general results in a relative displacement of any two points in the body. This displacement may cause the line joining the two points to (1) change in length only, (2) change in direction only or (3) change in both these respects. In a few simple cases the forces may be applied in a simple manner and the resulting strains can be easily defined and measured but in the case of bodies of complex shape the analysis of the strain becomes more complicated.

A logical presentation requires an examination of the two simple cases first, followed by their combination. Let us consider first the case in which the line joining the two points changes only in length. This is called simple extension.

In Fig. 1 the two points are O and b and the displacement of b to b' is clearly the result of two simple extensions, one in the X direction and one in the Y direction. The unit extensions are equal to du/dx and dv/dy respectively. Convention has adopted the symbols e_x and e_y to represent the unit extension or strain in the X and Y directions respectively, so we may write:

$$e_x = \frac{du}{dx} \text{ and } e_y = \frac{dv}{dy} \qquad (1)$$

The case in which the line joining the two points changes only in direction is called shear.

In Fig. 2 the two points are a and b and the line connecting them changes from ab to ab'. The angle γ_x is a numerical measure of the shear strain, which in this case is parallel to the Y axis (i. e., the Y direction). It is always small and therefore can be represented by the tangent of the angle.

$$\gamma_x = \frac{dv}{dx} \qquad (2)$$

Similarly in Fig. 3 the movement in the X direction would be measured by the angle bcb' which again could be represented by the tangent of the angle.

$$\gamma_y = \frac{du}{dy} \qquad (3)$$

The angles are measured in radians but since the values are small they are equivalent to strain in inches per inch if these are the units used.

Shear may occur in both the X and Y directions simultaneously and this more general case is illustrated in Fig. 4.

The prism $Oabc$ is distorted to $Oa'b'c'$ which involves shear in both of these directions. The total shear is measured by the angle representing the difference between angle $a'Oc'$ and a right angle. This is the sum of the two small angles aOa' and cOc' which can be

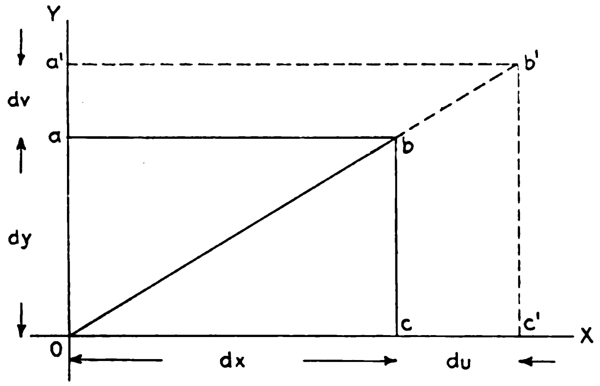


Fig. 1

measured by their respective tangents du/dy and dv/dx. But these quantities by equations (2) and (3) are the expressions for shear in the X and Y directions respectively. Therefore the total shear

$$\gamma_{xy} = \gamma_y + \gamma_x = \frac{du}{dy} + \frac{dv}{dx} \quad \ldots\ldots\ldots\ldots (4)$$

When the line joining the two points changes in both length and direction we have the most general case and the solution of this gives the components of strain at the point. These will be expressed in an equation of three terms. The first two give the simple extension in terms of the extensions in the X and Y directions and the third gives the shear component in both the X and Y directions.

In Fig. 5 the two points are O and b and it will be seen that when b is displaced to b' the line Ob changes in both length and direction. For the development of the equations for the components of strain at the point O it will be convenient to take a very small prism whose base is shown in Fig. 5. The line Ob is the diagonal of rectangular base $Oabc$.

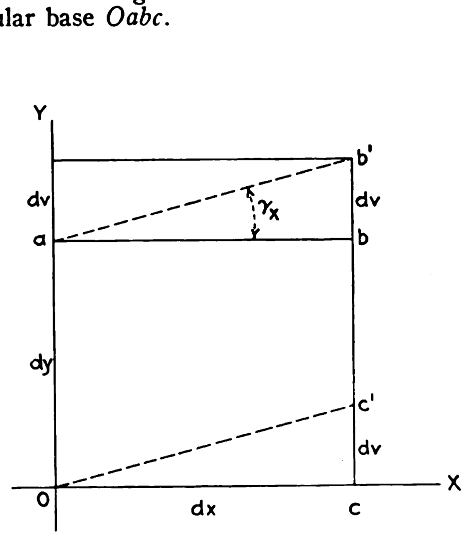


Fig. 2

In application of external forces which displaces b to b' distorts this rectangle $Oabc$ into the parallelogram $Oa'b'c'$ which does not have the same area as the original rectangle.

The following conventions will be adopted in connection with Fig. 5:

1. The original dimensions of the rectangle $Oabc$ will be taken as dx and dy and the original length of the diagonal ds.
2. The angle between OA and OX will be called α.
3. The projections of Ob' on the X and Y axes will be $dx + du$ and $dy + dv$ respectively.
4. The projections of Ob' on OA is Ob'' and equal to $ds + dR$.
5. Since the angle $b'Ob''$ is very small it can be assumed that angles bfg and $Ob'f$ are equal to α.
6. The unit extension of the diagonal Ob will be called e_A.

From the construction, the component bb'' of the displacement bb' is equal to

$$bb'' = dR = bg + gb'' = du \cos \alpha + dv \sin \alpha \ldots (5)$$

The unit extension along the diagonal Ob is

$$e_A = \frac{dR}{ds} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (6)$$

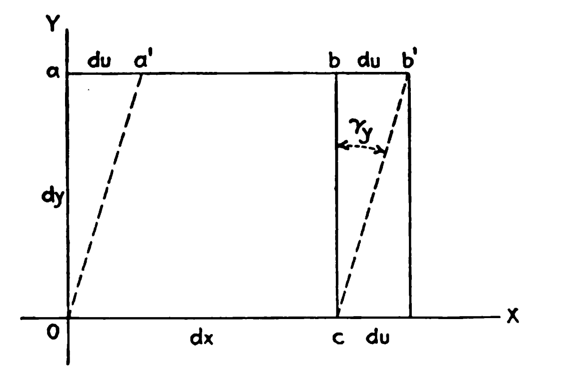


Fig. 3

The next step is to express the strain e_A in terms of the strain components along the X and Y axes. Although the area of the parallelogram $Oa'b'c'$ is, in general, not the same as that of the original rectangle $Oabc$, the deformation is the same as though it took place in two

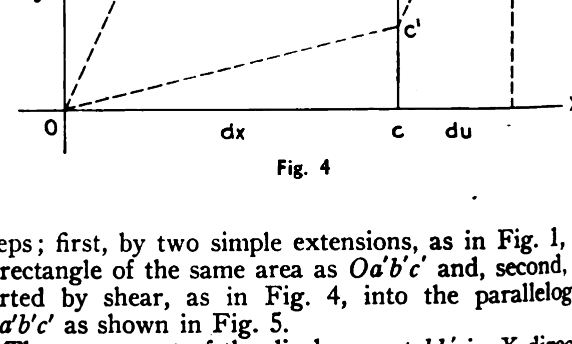


Fig. 4

steps; first, by two simple extensions, as in Fig. 1, into a rectangle of the same area as $Oa'b'c'$ and, second, distorted by shear, as in Fig. 4, into the parallelogram $Oa'b'c'$ as shown in Fig. 5.

The component of the displacement bb' in X direction is du and this is made up of simple extension of the

prism $Oabc$ in the direction OX and a simple shear in the same direction.

For each unit of dx there is a portion of du which is due to simple extension in the X direction. Analytically this is represented by the partial derivative, $\delta u/\delta x$ and the total displacement in the X direction due to simple extension would then be $(\delta u/\delta x)\ dx$. Similarly, for each unit of dy there is also a portion of du which is due to simple shear in the X direction which can be represented by $\delta u/\delta y$. The total displacement in the X direction due to this shear is $(\delta u/\delta y)\ dy$. The total displacement in the X direction due to both simple extension and shear is then expressed by the equation,

$$du = \frac{\delta u}{\delta x}\,dx + \frac{\delta u}{\delta y}\,dy \quad \ldots\ldots (7)$$

By the same procedure the following equation is derived for the displacement in the Y direction,

$$dv = \frac{\delta v}{\delta y}\,dy + \frac{\delta v}{\delta x}\,dx \quad \ldots\ldots (8)$$

These values for du and dv can be used to get another expression for e_A. Substituting them in equation (5) and then substituting the obtained value for dR in equation (6) we get:

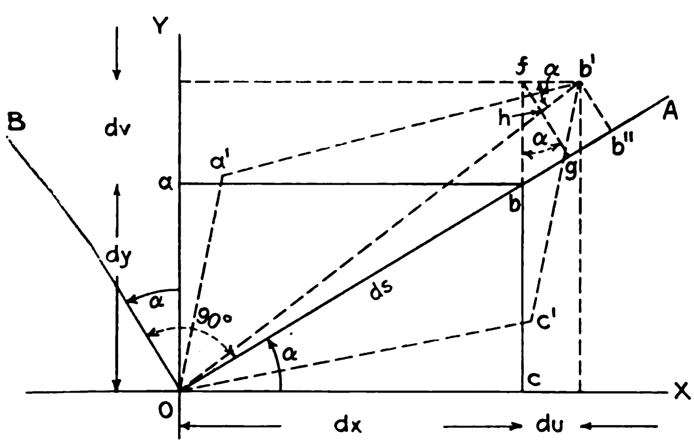


Fig. 5

$$e_A = \frac{\delta u}{\delta x}.\frac{dx}{ds}\cos\alpha + \frac{\delta u}{\delta y}.\frac{dy}{ds}\cos\alpha + \frac{\delta v}{\delta y}.\frac{dy}{ds}\sin\alpha + \frac{\delta v}{\delta x}.\frac{dx}{ds}\sin\alpha \quad \ldots (9)$$

From the construction of Fig. 5 $dx/ds = \cos\alpha$ and $dy/ds = \sin\alpha$. Furthermore we may make $\delta u/\delta x = e_x$ and $\delta v/\delta y = e_y$ since these are unit extensions in the X and Y directions. Also, $\frac{\delta u}{\delta y} + \frac{\delta v}{\delta x} = \gamma_{xy}$.

Substituting these values in equation (9)

$$e_A = e_x \cos^2\alpha + e_y \sin^2\alpha + \gamma_{xy} \sin\alpha\cos\alpha \quad \ldots\ldots (10)$$

To remove the second power terms we can make the following substitutions in equation (10) based on trigonometric relationship of the functions of double angles.

$$\sin\alpha\cos\alpha = 1/2\ \sin 2\alpha$$
$$\cos^2\alpha = 1/2\ (1 + \cos 2\alpha)$$
$$\sin^2\alpha = 1/2\ (1 - \cos 2\alpha)$$

which gives

$$e_A = 1/2\,(e_x+e_y) + 1/2\,(e_x-e_y)\cos 2\alpha + 1/2\,\gamma_{xy}\sin 2\alpha \quad \ldots (11)$$

The unit extension along the direction OB in Fig. 5 is obtained by substituting (90 deg. + α) for α in equation (11)

$$e_B = 1/2\,(e_x+e_y) - 1/2\,(e_x-e_y)\cos 2\alpha - 1/2\,\gamma_{xy}\sin 2\alpha \quad \ldots (12)$$

We now have expressions for the extension in any element making an angle α with OX (equation 11 or with OY (equation 12) and the next step is to determine the shearing strain. The total shear may be considered as the sum of the simple shears in the A and B directions similar to the treatment of Fig. 4 and equation (4). In Fig. 5, $b'b''$ may be considered as a component of the displacement bb' The ratio of $b'b''$ ($=dQ$) to Ob is equivalent to a simple shear in the direction OB.

$$\gamma_A = \frac{b'b''}{Ob} = \frac{dQ}{ds} \quad \ldots\ldots (13)$$

From the construction of Fig. 5 and the assumptions previously made,

$$b'b'' = dQ = fg - fh = dv\cos\alpha - du\sin\alpha \quad \ldots (14)$$

Substituting the values of dv and du from equations (7) and (8) in equation (14) and combining with equation (13)

$$\gamma_A = \frac{dQ}{ds} = \frac{\delta v}{\delta y}.\frac{dy}{ds}\cos\alpha + \frac{\delta v}{\delta x}.\frac{dx}{ds}\cos\alpha - \frac{\delta u}{\delta x}.\frac{dx}{ds}\sin\alpha - \frac{\delta u}{\delta y}.\frac{dy}{ds}\sin\alpha \quad \ldots (15)$$

But from Fig. 5 $dx/ds = \cos\alpha$ and $dy/ds = \sin\alpha$, so substituting and collecting terms, we have

$$\gamma_A = \frac{dQ}{ds} = \frac{\delta v}{\delta x}\cos^2\alpha - \frac{\delta u}{\delta y}\sin^2\alpha + \left(\frac{\delta v}{\delta y} - \frac{\delta u}{\delta x}\right)\sin\alpha\cos\alpha \quad \ldots (16)$$

To find the shear in the direction OA we can substitute (90 deg. + α for α in equation (16) if we take into account that this will be in the second quadrant where the signs of dx, $\cos\alpha$ and $\tan\alpha$ are negative. Since the shear is represented by the tangent of an angle in the second quadrant it also is negative.

$$-\gamma_B = \frac{\delta v}{\delta x}\sin^2\alpha - \frac{\delta u}{\delta y}\cos^2\alpha - \left(\frac{\delta v}{\delta y} - \frac{\delta u}{\delta x}\right)\sin\alpha\cos\alpha \quad \ldots (17)$$

or

$$\gamma_B = \frac{\delta u}{\delta y}\cos^2\alpha - \frac{\delta v}{\delta x}\sin^2\alpha + \left(\frac{\delta v}{\delta y} - \frac{\delta u}{\delta x}\right)\sin\alpha\cos\alpha \quad \ldots (18)$$

Adding equations (16) and (18) we obtain the value for the total shear in the directions OA and OB.

$$\gamma_{AB} = \gamma_A + \gamma_B = 2\left(\frac{\delta v}{\delta y} - \frac{\delta u}{\delta x}\right)\sin\alpha\cos\alpha + \left(\frac{\delta v}{\delta x} + \frac{\delta u}{\delta y}\right)(\cos^2\alpha - \sin^2\alpha) \quad \ldots (19)$$

But $\frac{\delta v}{\delta y} = e_y$

$\frac{\delta u}{\delta x} = e_x$

$2\sin\alpha\cos\alpha = \sin 2\alpha$

$\cos^2\alpha - \sin^2\alpha = \cos 2\alpha$

$$\left(\frac{\delta v}{\delta x} + \frac{\delta u}{\delta y}\right) = \gamma_{xy}$$

Therefore

$$\gamma_{AB} = (e_y - e_x)\sin 2\alpha + \gamma_{xy}\cos 2\alpha \quad \ldots\ldots (20)$$

As previously stated, when the state of stress at a point is fully determined it is seen that it has a maximum and

a minimum value in directions which are mutually perpendicular. Since equation (10) gives the unit extension as a function of the angle α with the X axis we can determine the angles which the maximum and minimum stresses make with the X axis by setting the first derivative of this expression equal to zero and solving for the roots.

$$e = e_x \cos^2\alpha + e_y \sin^2\alpha + \gamma_{xy} \sin\alpha \cos\alpha \qquad (21)$$

The first derivative of e with respect to α is as follows:

$$\frac{de}{d\alpha} = (e_y - e_x) \sin 2\alpha + \gamma_{xy} \cos 2\alpha \qquad (22)$$

Let
$$(e_y - e_x) \sin 2\alpha + \gamma_{xy} \cos 2\alpha = 0 \qquad (23)$$

Then
$$\frac{\sin 2\alpha}{\cos 2\alpha} + \frac{\gamma_{xy}}{e_y - e_x} = 0 \qquad (24)$$

Therefore
$$\tan 2\alpha = \frac{-\gamma_{xy}}{e_y - e_x} = \frac{\gamma_{xy}}{e_x - e_y} \text{ and } \alpha$$
$$= \tfrac{1}{2} \tan^{-1}\left(\frac{\gamma_{xy}}{e_x - e_y}\right) \qquad (25)$$

For a given numerical value of the tangent there must be, from trigonometric relationships, two angles 180 deg. apart and in equation (25) these angles are the two values of 2α.

This shows that there are two values for a which differ by 90 deg. and in such a case one must correspond to a maximum and the other a minimum value of e. These are the directions of the principal strains and since equation (23) is identical with the equation for shear (20) it will be understood that the shear must be zero in the direction of maximum and minimum strain.

Equations (11), (12) and (20) give the components of strain in any two mutually perpendicular directions A and B which make an angle α with the X and Y axes respectively in terms of the displacements in the X and Y directions. If we assume that X and Y are the directions of the principal strains we can derive expressions for components of strain in terms of the principal strains. Since the shear is always zero in the direction of the principal strains $\gamma_{yx} = 0$ in this case.

Under these assumptions equations (11) and (12) become

$$e_A = \tfrac{1}{2} (e_x + e_y) + \tfrac{1}{2} (e_x - e_y) \cos 2\alpha \qquad (26)$$

$$e_B = \tfrac{1}{2} (e_x + e_y) - \tfrac{1}{2} (e_x - e_y) \cos 2\alpha \qquad (27)$$

If we add (26) and (27) we find

$$e_A + e_B = e_x + e_y \qquad (28)$$

This shows that the sum of the strains in any two mutually perpendicular directions must always equal the sum of the principal strains. Therefore, the sum of the strains in any two mutually perpendicular directions is always equal to the sum of the strains in any other two mutually perpendicular directions. It will be shown later that herein lies one of the great advantages of using rosettes with four gage lines consisting of two sets of lines mutually perpendicular.

Continuing the assumption that the principal strains are still in the direction of the X and Y axes we can determine the magnitude and direction of the maximum shear strain in terms of the principal strains which are now e_x and e_y.

The equation for total shear in any two mutually perpendicular directions A and B which make an angle a with the X and Y axes respectively in terms of displacements in the X and Y directions is given by equation (20) as follows

$$\gamma_{AB} = (e_y - e_x) \sin 2\alpha + \gamma_{xy} \cos 2\alpha$$

But in this case the shear in the direction of the principal strains (X and Y) is zero and therefore this becomes

$$\gamma_{AB} = (e_y - e_x) \sin 2\alpha \qquad (29)$$

This has a maximum value when $\alpha = 45$ deg. in which case

$$\gamma_{AB} = e_y - e_x \qquad (30)$$

This shows that the maximum shear strain due to the principal strains is equal to their algebraic difference and bisects the angle between them.

In the general case when the direction of the principal strains is unknown, equation (25) can be used to find the angle α which they make with the X and Y axes.

$$\tan 2\alpha = \frac{\gamma_{xy}}{e_x - e_y} \qquad (31)$$

It will be more convenient if the quantity γ_{xy} can be expressed in terms of strains measured on some other pair of mutually perpendicular gage lines whose directions may be taken in general as A and B making an angle α with some other pair of mutually perpendicular gage lines.

Subtracting equation (12) from (11):

$$e_A - e_B = (e_x - e_y) \cos 2\alpha + \gamma_{xy} \sin 2\alpha \qquad (32)$$

From this it is seen that when $\alpha = 45$ deg.

$$\gamma_{xy} = e_A - e_B \text{ or } \gamma_{xy} = -(e_B - e_A) \qquad (33)$$

In other words, if the two sets of mutually perpendicular gage lines make an angle $\alpha = 45$ deg. with each other, the shear strain resulting from one set is equal to the difference in strains measured on the other set.

We can substitute this in equation (31) to get:

$$\tan 2\alpha = \frac{-(e_B - e_A)}{(e_x - e_y)} \qquad (34)$$

Application of the Theory to a Rosette with Four Intersecting Gage Lines 45 Degrees Apart

As discussed in the preceding section, there is a marked advantage in using a rosette with the gage lines located as shown in Fig. 6. If the gage lines are designated as

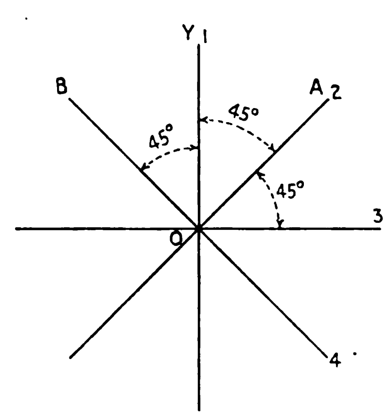


Fig. 6

shown the strains measured can be denoted by e_1, e_2, e_3 and e_4. It will be seen that e_1 and e_3 correspond to e_y and e_x and e_2 *and* e_4 to e_A and e_B, respectively.

We can now write

$$\gamma_{xy} = -(e_4 - e_2) \quad \ldots\ldots (35)$$

Keeping e_A and e_B to designate the general case of strain in any pair of mutually perpendicular directions but substituting e_1, e_2, e_3 and e_4 for e_x, e_y and γ_{xy} equations (11) and (12) become

$$e_A = \tfrac{1}{2}(e_3 + e_1) + \tfrac{1}{2}(e_3 - e_1)\cos 2a - \tfrac{1}{2}(e_4 - e_2)\sin 2a \quad \ldots\ldots (36)$$

$$e_B = \tfrac{1}{2}(e_3 + e_1) - \tfrac{1}{2}(e_3 - e_1)\cos 2a + \tfrac{1}{2}(e_4 - e_2)\sin 2a \quad \ldots\ldots (37)$$

It will be seen that the first term in each of these equations involves strain measurements on only two of the four gage lines of the rosette shown in Fig. 6. It is possible, however, to bring into the computation the measurements on the other two gage lines and thus increase the accuracy of the result by averaging the errors of all four measurements.

Since $e_3 + e_1 = e_4 + e_2$ we may substitute for $\tfrac{1}{2}(e_3 + e_1)$ in each of these equations, the value $\tfrac{1}{4}(e_1 + e_2 + e_3 + e_4)$*. Since $\tan 2a = \dfrac{-(e_4 - e_2)}{(e_3 - e_1)}$ and in this case a is the angle of the principal strains, we may also substitute in equations (36) and (37) the following values for $\sin 2a$ and $\cos 2a$ which are obtainable from direct trigonometric relationships.

$$\sin 2a = \frac{-(e_4 - e_2)}{\sqrt{(e_3 - e_1)^2 + (e_4 - e_2)^2}} \quad \ldots\ldots (37a)$$

$$\cos 2a = \frac{(e_3 - e_1)}{\sqrt{(e_3 - e_1)^2 + (e_4 - e_2)^2}} \quad \ldots\ldots (37b)$$

We then have for the principal strains

$$e_A = \tfrac{1}{2}\left[\tfrac{1}{2}(e_1 + e_2 + e_3 + e_4) + \sqrt{(e_3 - e_1)^2 + (e_4 - e_2)^2}\right] \quad \ldots\ldots (38)$$

$$e_B = \tfrac{1}{2}\left[\tfrac{1}{2}(e_1 + e_2 + e_3 + e_4) - \sqrt{(e_3 - e_1)^2 + (e_4 - e_2)^2}\right] \quad \ldots\ldots (39)$$

The next step is to develop an expression for the maximum shear in terms of the strains measured on the four gage lines. The general equation for the shear strain is

$$\gamma_{AB} = (e_y - e_x)\sin 2a + \gamma_{xy}\cos 2a \quad \ldots\ldots (40)$$

If the principal strains are in the directions A and B as in the present case $\gamma_{AB} = 0$ and as has been shown, the maximum shearing strains will be at 45 deg. from A and B. Since A and B are at an angle a from X and Y the maximum shearing strains will be at $a + 45$ deg. from X and Y. Substituting $a + 45$ deg. for a in equation (40) we get

$$\gamma_{max} = (e_y - e_x)\cos 2a - \gamma_{xy}\sin 2a \quad \ldots\ldots (41)$$

But $e_y = e_1$; $e_x = e_3$; and $\gamma_{xy} = -(e_4 - e_2)$

Therefore:

$$\gamma_{max} = (e_1 - e_3)\cos 2a + (e_4 - e_2)\sin 2a \quad \ldots\ldots (42)$$

Or:

$$\gamma_{max} = -(e_3 - e_1)\cos 2a + (e_4 - e_2)\sin 2a$$

Substituting equations (37a) and (37b) in (42)

$$\gamma_{max} = \sqrt{(e_3 - e_1)^2 + (e_4 - e_2)^2} \quad \ldots\ldots \mathbf{(43)}$$

It will be noted that this same result would be obtained by subtracting the values for e_B from e_A given in equations (38) and (39).

The Development of Equations for Combined Stress

The conversion of the strain readings into the correct values for stress in different directions at the point O in Fig. 6 will be the next step.

A unit tensile stress σ_x acting in the direction of the X axis will produce a unit elongation in this direction equal to σ_x/E, where E is the modulus of elasticity. This stress will also produce a lateral contraction which is proportional to the unit elongation in the X direction in the ratio of the constant m which is called Poisson's ratio. The contraction in the Y direction will be $-m\sigma_x$/E. Similarly a unit tensile stress σ_y acting in the direction of the Y axis will produce a unit elongation in this direction equal to σ_y/E and a unit contraction in the X direction equal to $-m\sigma_y$/E.

2. If both stresses act simultaneously, the unit elongations in the x and y directions will be

$$e_x = \frac{\sigma_x}{E} - \frac{m\sigma_y}{E} \quad \ldots\ldots (44)$$

$$e_y = \frac{\sigma_y}{E} - \frac{m\sigma_x}{E} \quad \ldots\ldots (45)$$

Rearranging, we get,

$$\sigma_x = e_x E + m\sigma_y \quad \ldots\ldots (46)$$

$$\sigma_y = e_y E + m\sigma_x \quad \ldots\ldots (47)$$

Substituting the values for σ_x and σ_y and solving for σ_x and σ_y we have,

$$\sigma_x = \frac{E}{1-m^2}(e_x + me_y) \quad \ldots\ldots (48)$$

$$\sigma_y = \frac{E}{1-m^2}(e_y + me_x) \quad \ldots\ldots (49)$$

Equations (48) and (49) may be used to determine the combined stress resulting from any two strains at right angles to each other. To determine the principal stresses, the principal strains should be substituted in these equations. The principal stresses as already mentioned are the maximum and minimum values of stress at the point O in Fig. 6 and are designated as σ_u and σ_v respectively. The maximum stress does not necessarily have the greatest numerical value but is highest in the positive sense while the minimum stress is lowest. Thus the maximum stress could be -2000 and the minimum stress -8000 lb. per sq. in.

The next step is to get equations (48) and (49) in a form in which the strains measured on the four gage lines can be substituted instead of values of e_x and e_y.

* In practice, $e_3 + e_1$ does not always equal $e_4 + e_2$ because of the human element handling the gage, unnoticed particles of dirt in the gage holes, or the slight error which is present in most gages. The value $\tfrac{1}{4}(e_1 + e_2 + e_3 + e_4)$ takes into consideration all four gage readings and reduces the error.

Substituting the values of the principal strains from equations (38) and (39) in equations (48) and (49) we get new expressions for the principal stresses σ_u and σ_v.

$$\sigma_u = \frac{E}{1-m^2}\left(\tfrac{1}{2}\left[\tfrac{1}{2}(e_1 + e_2 + e_3 + e_4) + \sqrt{(e_3 - e_1)^2 + (e_4 - e_2)^2}\right] + \frac{m}{2}\left[\tfrac{1}{2}(e_1 + e_2 + e_3 + e_4) - \sqrt{(e_3 - e_1)^2 + (e_4 - e_2)^2}\right]\right) \quad (50)$$

Which can be reduced to

$$\sigma_u = \frac{E}{2(1+m)}\left(\tfrac{1}{2}\frac{(1+m)}{(1-m)}(e_1 + e_2 + e_3 + e_4) + \sqrt{(e_3 - e_1)^2 + (e_4 - e_2)^2}\right) \quad (51)$$

Similarly

$$\sigma_v = \frac{E}{2(1+m)}\left(\tfrac{1}{2}\frac{(1+m)}{(1-m)}(e_1 + e_2 + e_3 + e_4) - \sqrt{(e_3 - e_1)^2 + (e_4 - e_2)^2}\right) \quad (52)$$

The maximum shear stress $\sigma\gamma$ is given as follows where G is the modulus of elasticity in shear and equal to $E/2(1 + m)$

$$\sigma\gamma = G_e\gamma \quad (53)$$

From equation (43) the maximum shear strain is substituted in (53) to get

$$\sigma\gamma = \frac{E}{2(1+m)}\sqrt{(e_3 - e_1)^2 + (e_4 - e_2)^2} \quad (54)$$

It was shown that the maximum shear *strain* due to the principal strains was equal to their algebraic difference and it will now be shown that the maximum shear *stress* is equal to *one half* the algebraic difference between the principal *stresses.*

Subtract equation (52) from (51)

$$\sigma_u - \sigma_v = \frac{E}{1+m}\sqrt{(e_3 - e_1)^2 + (e_4 - e_2)^2} \quad (55)$$

Therefore

$$\tfrac{1}{2}(\sigma_u - \sigma_v) = \frac{E}{2(1+m)}\sqrt{(e_3 - e_1)^2 + (e_4 - e_2)^2} = \sigma_\gamma \quad (56)$$

This always gives the maximum shear stress in the plane of the rosette but it will be seen that when σ_u and σ_v are of the same sign, one half of their difference will be less than the quantity $\tfrac{1}{2}(0 - \sigma_u)$. This means that when σ_u and σ_v are of the same sign there is a higher shear stress in the body than that in the plane of the rosette. By assuming the stress in the Z direction (perpendicular to the plane of the rosette) as zero and applying the reasoning developed above this greater "maximum" stress can be determined and will be in a plane at 45 deg. to the plane of the rosette.

The Derivation of Equations for Stress in any Direction

We will now derive the general equation for determining the stress in any direction through the point O in Fig. 6.

Using the form of equation (48)

$$\sigma_A = \frac{E}{1-m^2}(e_A + me_B) \quad (57)$$

Substituting values of e_A and e_B from equations (36) and (37) and using $\tfrac{1}{2}(e_1 + e_2 + e_3 + e_4)$ in place of $(e_3 + e_1)$

$$\sigma_A = \frac{E}{2(1+m)}\left(\frac{1+m}{2(1-m)}(e_1 + e_2 + e_3 + e_4) + (e_3 - e_1)\cos 2\alpha - (e_4 - e_2)\sin 2\alpha\right) \quad (58)$$

The values of e_1, e_2, e_3, and e_4 are the strains measured on gage lines *1, 2, 3,* and *4* of Fig. 6 by means of a strain gage. The readings are taken in dial divisions which can be converted to strain in inches per inch by the relationship $e = Kd$ where d is the number of dial divisions and K is the constant for the gage used.

The laborious task of converting each deformation from dial divisions to units of strain can be avoided by the incorporation of the constant K in equation (58) and using the notation d_1, d_2, d_3, and d_4 to designate the number of gage divisions (difference between initial and final readings). All of the readings in the rosette must of course be made with the same gage.

Equation (58) then becomes

$$\sigma_A = \frac{KE}{2(1+m)}\left(\frac{1+m}{2(1-m)}(d_1 + d_2 + d_3 + d_4) + (d_3 - d_1)\cos 2\alpha - (d_4 - d_2)\sin 2\alpha\right) \quad (59)$$

This equation can be used to determine the stress at any angle α measured positive counter clockwise from the X axis. There are certain directions of particular interest for which it will be worth while to derive special equations for determining the stress; these are the directions of the gage lines in the rosette shown in Fig. 6. For gage line *1* the augle $\alpha = +90$ deg. and $2\alpha = 180$ deg.

$$\sigma_1 = \frac{KE}{2(1+m)}\left(\frac{1+m}{2(1-m)}(d_1 + d_2 + d_3 + d_4) - (d_3 - d_1)\right) \quad (60)$$

For gage line *2* the angle $\alpha = +45$ deg. and $2\alpha = 90$ deg.

$$\sigma_2 = \frac{KE}{2(1+m)}\left(\frac{1+m}{2(1-m)}(d_1 + d_2 + d_3 + d_4) - (d_4 - d_2)\right) \quad (61)$$

For gage line *3* the angle $\alpha = 0$

$$\sigma_3 = \frac{KE}{2(1+m)} \left(\frac{1+m}{2(1-m)} (d_1 + d_2 + d_3 + d_4) + (d_3 - d_1) \right) \quad (62)$$

For gage line *4* the angle $\alpha = 135$ deg. and $2\alpha = 270$ deg.

$$\sigma_4 = \frac{KE}{2(1+m)} \left(\frac{1+m}{2(1-m)} (d \ + d_2 + d_3 + d_4) + (d_4 - d_2) \right) \quad (63)$$

Determination of the Direction of the Maximum Stress

From equation (34) we can derive from the measured deformations on the four gage lines an expression which enables us to determine the angle a which the maximum stress σ_u makes with the X axis.
This equation is

$$\tan 2a = \frac{-(e_B - e_A)}{(e_x - e_y)}$$

The right hand side of this equation is a ratio of differences in strains which are proportional to corresponding dial divisions (difference between initial and final readings). Therefore we can write

$$\tan 2a = \frac{-(d_4 - d_2)}{(d_3 - d_1)} = \frac{-\mathrm{b}}{\mathrm{a}} \quad \ldots\ldots\ldots\ldots (64)$$

The angle α is measured positive counter-clockwise from the X axis (gage line *3*) toward the maximum and while the numerical value of the tangent does not depend on the algebraic signs of the quantities on the right hand side of the equation it is necessary to take the signs into consideration in order to locate the angle. Fig. *7* will be of considerable help in this regard. The signs of the numerator and denominator are indicated on rectangular axes and the angle (2α) will fall in the quadrant corresponding to the signs of these two terms. The location of the angle α can then be readily determined.

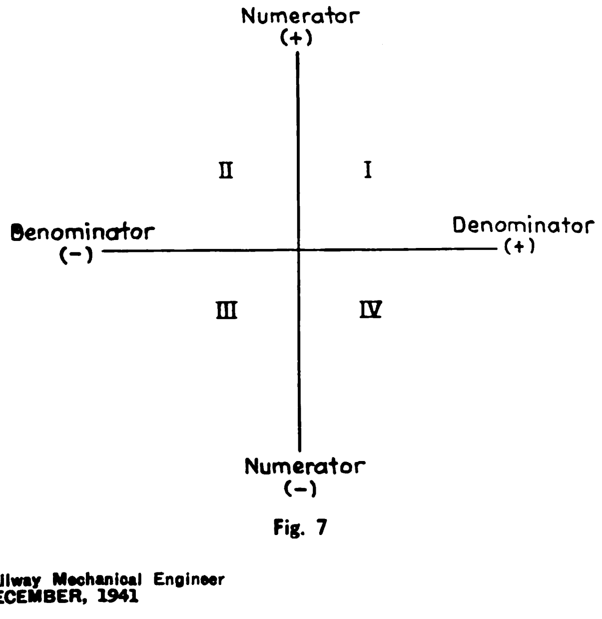


Fig. 7

Working Formulas for Computing all Stresses in Steel

The equations up to this point are all general in that they can be applied to any elastic material by substitution of the proper elastic constants. When a large amount of work is to be done on one type of material for which these values are essentially unchanged it is advantageous to incorporate the elastic constants in the working equations. For high carbon steel the following have been extensively used and are as good as the experimental data can furnish.

$$\mathrm{E} = 29 \times 10^6 \text{ lb. per sq. in.}$$

$$m = 0.3$$

Also let $(d_1 + d_2 + d_3 + d_4) = \Sigma$, and $(d_3 - d_1) = \mathrm{a}$, and $(d_4 - d_2) = \mathrm{b}$ and $(a^2 + b^2) = \mathrm{c}$.

If these quantities a, b, and c, together with the above numerical values for E and m are substituted in equations (51), (52), (60), (61), (62), and (63) it is found that considerable simplification is obtained. For example

$$\frac{K\,\mathrm{E}}{2(1+m)} = 11.15 \times 10^6 K$$

and

$$\frac{1+m}{2(1-m)} = 0.93$$

This gives the following working equations.

$$\sigma_{max} = 11.15 \times 10^6 K \ [0.93\Sigma + \mathrm{c}] \quad \ldots\ldots\ldots\ldots (65)$$

$$\sigma_{min} = 11.15 \times 10^6 K \ [0.93\Sigma - \mathrm{c}] \quad \ldots\ldots\ldots\ldots (66)$$

$$\sigma_1 = 11.15 \times 10^6 K \ [0.93\Sigma - \mathrm{a}] \quad \ldots\ldots\ldots\ldots (67)$$

$$\sigma_2 = 11.15 \times 10^6 K \ [0.93\Sigma - \mathrm{b}] \quad \ldots\ldots\ldots\ldots (68)$$

$$\sigma_3 = 11.15 \times 10^6 K \ [0.93\Sigma + \mathrm{a}] \quad \ldots\ldots\ldots\ldots (69)$$

$$\sigma_4 = 11.15 \times 10^6 K \ [0.93\Sigma + \mathrm{b}] \quad \ldots\ldots\ldots\ldots (70)$$

Similar substitution in equation (59) gives the following equation for finding the stress in any direction α, measured positive counter-clockwise from the X axis (gage line *3*).

$$\sigma a = 11.15 \times 10^6 K \ [0.93 + a \cos 2a - b \sin 2a] \ldots\ldots\ldots (71)$$

The constant K will vary from gage to gage but when a large amount of work is done with one gage this constant can be incorporated in the above equations as a fixed value (in which case let $11.15 \times 10^6 K = K^1$).
The maximum shearing stress

$\sigma\gamma = \frac{1}{2} (\sigma_{max} - \sigma_{min})$ when σ_{max} and σ_{min} are of opposite sign
$\sigma_\gamma = \frac{1}{2} \sigma_{max}$ or $\frac{1}{2} \sigma_{min}$ when they are of the same sign, whichever gives larger numerical value.

The angle of the principal stress is given by

$$\tan 2a = \frac{-(\mathrm{d}_4 - \mathrm{d}_2)}{(\mathrm{d}_3 - \mathrm{d}_1)} = \frac{-\mathrm{b}}{\mathrm{a}} \text{ according to Fig. 7.}$$

(*To be continued*)

EDITORIALS

Our Prize Competition

Don't overlook the fact that the *Railway Mechanical Engineer* competition for the best articles on ways and means of improving mechanical department operations or practices to increase production and secure a larger use from the equipment and facilities, announced in our October number, will close on January 15, 1942. We are delighted with the wide interest that has been shown in the announcement of this competition. Certainly there never was a time when it was more important to eliminate waste and lost motion and speed up the productive capacity of our transportation system. Mail your article as early as possible and do not run the risk of its not reaching us by January 15.

A Blow to Technical Progress

In this issue is an article describing a box-car design recently developed by the Chicago, Milwaukee, St. Paul & Pacific, from which 500 cars have been built. The car body is a completely welded structure and in its design are many unique features. This design is typical of the developments which have constantly been taking place on American railroads under our system of private enterprise which offers the minimum of restriction to the exercise of initiative and ingenuity on the part of every group in the field.

Another article in this issue records the announcement of the Association of American Railroads of its proposed drastic limitation of the number of car designs from which orders will be placed by the railroads for general service during the present emergency. The announced purpose of this proposal is to comply with the desire of the O. P. M. so that the latter, in turn, may be induced to be generous with the railroads and the car builders in their allocation of materials needed to effect the proposed increase in freight-car ownership to 1,800,000 by October 1, 1942.

The conflict presented by these two articles is typical of the general conflict which must be faced by every democracy in time of peril. The strength of a democracy is measured by the willingness of its citizens to forego the exercise of cherished rights and privileges in the face of outside peril, and by their ability to regain the exercise of those rights and privileges when the emergency is over.

A program of standardization such as that proposed by the A. A. R. will simplify the entire problem of production and allocation of steel, which plays so important a part in meeting the rapidly expanding demands of our defense program. It will also simplify production problems of the car builders. To this there will probably be little dissent. But there will be much less complete agreement that the particular designs proposed are the best which could be chosen. In defense of them it must be said that no set of standards which are to be accepted without compulsion can be much higher than the least common denominator in the state of the art.

The irony of the situation in which the raliroads find themselves is that much of the equipment that will be purchased to meet the emergency will be far on its way to becoming obsolete before it moves a mile. If the cars built now under such a program could be disposed of when the emergency is over, their effects would be much less disturbing. But they will act like balls and chains on the progress of the railroads, preventing, for the better part of another generation, their benefiting from materials and methods of construction available now.

Get What You Need While You Can

Every railroad officer and supervisor who has any influence whatsoever upon the selection and purchase of equipment used in the maintenance of motive power and rolling stock knows from long experience that the best time to get new equipment is when his road is "in the black" and the management is receptive to requests for the necessary expenditures. When traffic falls off, and with it, earnings, the natural inclination of management is to curtail expenses, particularly expenditures for new equipment the pressing need for which has passed.

There are, under present conditions, several rather negative attitudes on the part of railroad men concerning the acquisition of shop equipment which indicate that the problem is not being studied as carefully as it should be. There are those who assume—erroneously in many cases—that because the machine tool and shop equipment manufacturers are loaded up with defense orders it wouldn't be any use of thinking about buying anything because it couldn't be delivered anyway. So why bother? Another attitude is that under the priorities system—which seems to be a deep mystery to many railroad men—the O. P. M. wouldn't let a railroad have a machine or a tool if it needed it the worst way. Both of these, and many other, similar assumptions are wrong in so far as many of the things the railroad shops need are concerned.

Of all of the negative thinking on the part of railroad men that by those who fail to recognize that the railroads are in themselves a defense industry, vital to the success of the entire defense program, is the most shortsighted of all.

Certainly, many of the machine tools that a railroad uses are also needed by defense industries engaged directly in the production of munitions for the Army and the Navy. It is but right that these needs should be met as quickly as possible and the established government agencies are set up to see that this is done. But, there are many other types of equipment not as drastically needed by defense industries on which railroads, or industry, can get surprisingly satisfactory deliveries —for these times.

These things being true we raise the question: "How do you know what you can or can not get if you haven't made any efforts to get it?" To the man who assumes that the manufacturer can not deliver: "How can you be sure what and when he can deliver if you make no effort to find out?" To the man who assumes that a railroad cannot get a priority rating high enough to be of any value we say: "How do you know what rating you can get if you haven't made formal application for a rating?" Information that comes to us day by day offers convincing evidence that many people in reresponsible positions in the railroad industry are not too well posted on ways and means of getting the things that are badly needed to maintain the high standard of rail transportation which has so far enabled the industry to break many all-time records.

For almost 10 years the railroads did very little in the way of a program of shop modernization with the result that when the present emergency stimulated rail traffic and started putting the pressure on the shops the equipment in most of these shops, judged by the average age of all shop units, had reached an all-time low point in the scale of obsolescence. It is true that many shop tools have enjoyed a service life in years somewhat beyond that reasonably to be expected in other industries, mostly because the usage, in machine-hours, for example, in the railroad industry has always been much lower than in many other industries. That is why a 30-year-old machine may, in some cases, be in reasonably good condition, from a mechanical standpoint, and still be obsolete from a production standpoint because it can't compete with a modern machine.

A next important factor is that for the past year the shops have been working under pressure and machine tools and other shop equipment have been in service one to three full shifts each day. At the present rate of use more of the service life of many shop units will have been used up in the current two-year period than would ordinarily be used in from six to eight such years as 1935 or 1936. All of this points to the fact that railroad shops are going to need new tools and shop equipment in from six months to two years from now more than they have ever needed them in the past 20 years if for no better reason than that they are wearing out already obsolete equipment at a faster rate than at any time in that period.

There may be those who feel that because deliveries are slow and prices are higher this is not the time to order the equipment that will soon be needed but we would like to pay our respects to the railway officer whose present practice shows that he faces a situation realistically. His decision is that he will now place orders for needed equipment under the most favorable terms possible with the full knowledge, born of years of railroad experience, that if he waits until prices are lower and deliveries are shorter it will probably be because the time will have come when business has fallen off and, to use his own words, "Then try and get the management to approve an A. F. E.! No, I'll take mine now while the getting is good." This, it seems to us, is a good policy for railroad men to adopt and for manufacturers to recognize. Early reports of shop equipment purchased during 1941 indicate that this particular officer was not alone in the application of such a policy.

Free Smokes For Broken Records

According to "Steel in Defense," a monthly leaflet published by the American Iron and Steel Institute, one steel mill in the Pittsburgh district has established the practice of passing the cigar box around each time any of its mill crews or departments sets a new production record. During June, July and August, so many new records were hung up, mostly on defense orders, that the company had to deal out 40,925 cigars, 16,450 packs of cigarettes, 500 stogies, and 192 packs of chewing tobacco. Non-smokers and non-chewers among the men divided up 339 lb. of candy.

The purpose of mentioning this practice of one of the steel mills is not necessarily to suggest that railroads can or should adopt the idea and distribute tobacco in one form or another as an incentive for breaking production records at railway locomotive shops, car shops and engine terminals. Vital as is the need for steel today, however, is it not a fact that rail transportation occupies a position of even greater importance in our scheme of industrial production and national defense than does the manufacture of any single commodity? Assuming that this question is answered in the affirmative, as indeed it must be, is it not highly essential to increase the efficiency and stimulate production in every department of railway operation, including particularly the mechanical department which has the important responsibility of keeping cars and locomotives in condition to handle the nation's traffic safely and satisfactorily at all times?

Railway equipment-maintenance practices are pretty well standardized and doubtless some shops and enginehouses could be found throughout the country which have not benefited by the installation of a single new machine tool, or possibly even a new idea, in several

years. It may be said with equal certainty that no shop or enginehouse has been so successful in securing improved machinery and installing new methods that no further improvement is possible. Obviously, the present would be an excellent time for railway mechanical officers and shop supervisors to take an inventory of their maintenance facilities as regards both tools and personnel and see what can be done to improve both. One constructive step would apparently be to stimulate healthy competition between individual shops on the same railway to the fullest extent practicable and also to set up in each shop and sub-department measuring sticks by which its weekly or monthly performance can be checked with previous records, weak points in the equipment or organization discovered and more or less continuous improvement secured. Fortunately, well-developed campaigns of this nature are already producing good results in the progressive mechanical departments of a number of railways, so general information regarding what needs to be done and what results may be expected is not difficult to obtain.

As pointed out in these columns many times before, the importance of the human reactions in any program of shop improvement can hardly be overestimated. In considering plans for increased output, reduced locomotive or car days in shop and reduced unit repair costs, it is obvious that every means should be exhausted to attract the interest of the shop men who actually do the work and give them definite incentives, not necessarily to work harder, but to eliminate waste effort, use their heads to save their backs, develop all possible short cuts which can be put in effect without sacrifice of quality workmanship and increase their individual and group efficiencies.

The charge is often made with some degree of justification that railway shop operations are pretty much "cut and dried," often dirty and seldom mentally stimulating to the men in overalls who do essentially the same kind of work, day after day. Admitting the essential difficulty of the job, why would it not be possible to visualize and dramatize such operations as the fitting of locomotive driving rods, washing out boilers, or repairing car trucks and show how, without this work, it would be impossible to feed or clothe the nation, or even move the guns, armament and troops needed for its defense? Railway men are not less aggressive, less progressive or less patriotic citizens than those employed in steel mills, once their imaginations are aroused, and it is definitely the responsibility of railway mechanical managements to develop and seize upon every new idea which promises to impress equipment maintenance forces with the vital importance of their work, especially in the present emergency, and encourages them to greater individual efforts in its performance.

If "smokes" are needed to put railway shop and enginehouse forces on their toes, smokes they should have! If some other idea apparently will produce better results, it should be developed and put into effect without delay.

Why Were They Honored?

A most unusual series of events took place early last June, when three universities in widely separated parts of our nation, bestowed honorary degrees upon the heads of three railway mechanical departments.

On June 6, George McCormick, general superintendent motive power of the Southern Pacific Company, was given the honorary degree of Doctor of Engineering by his Alma Mater, Texas Agricultural and Mechanical College. Three days later Frederick W. Hankins, assistant vice-president of the Pennsylvania Railroad, was given the honorary degree of Doctor of Science by Bucknell University. On June 11, K. F. Nystrom, mechanical assistant to the chief operating officer of the Chicago, Milwaukee, St. Paul & Pacific, was awarded the honorary degree of Doctor of Engineering by Marquette University.

Such things do not just happen. Degrees of this kind are not distributed carelessly. It is quite unusual, also, for such honors to be bestowed upon railway mechanical department officers. Why were these three men selected? What qualities do they possess; what have they accomplished to merit this distinction?

The *Railway Mechanical Engineer* will attempt to answer these questions in a series of three rather intimate articles about these men. The first one, in the order of the date of the Commencement exercises, will appear in our next, or January, 1942, issue, and the other two in consecutive issues. We know that they will be an inspiration to all of the officers of the mechanical department, and particularly to the younger men who are starting in at the bottom of the ladder and are striving to improve themselves, so that they may qualify for greater recognition and advancement in the days to come.

New Books

MANUAL OF ORDINANCES AND REQUIREMENTS IN THE INTEREST OF AIR POLLUTION, SMOKE PREVENTION AND FUEL COMBUSTION. *176 pages, 6 in. by 9 in. Bound in paper. Official publication of the Smoke Prevention Association of America, Inc., 139 North Clark Street, Chicago, Ill. Price, Sixty Cents.*

This manual includes information for those interested in eliminating smoke and air pollution in our towns and cities. It includes a model smoke abatement ordinance. The greater part of the book is devoted to the proceedings of the thirty-fifth annual convention of the Smoke Prevention Association. Of special interest to railroaders are papers on Cyclone and Anderson Front Ends for Locomotives—Spark Arresters Without Netting by Leslie R. Pyle, Locomotive Firebox Company; Railroad Smoke Problems and Stoker Firing by Samuel A. Dickson, fuel supervisor, Alton Railroad; Grate Design and Its Influence on the Burning of Fuel and on the Abatement of Smoke by J. W. Hulson, president, Hulson Grate Company; and Abating Locomotive Smoke in Chicago by A. Deutch and S. Radner.

THE READER'S PAGE

Standard Locomotives For American Railways

To the Editor:

Standard locomotives have long been a favorite theme of those who believe that regimentation is synonymous with efficiency. Projects for the complete standardization of steam locomotives can be traced back as far as 1840. While the earliest schemes were put into effect in England, three other countries, the United States, Germany and British India have engaged in the practice most extensively.

If the benefits sought from the standardization of locomotives are to be obtained, it is obvious that the standard designs must remain essentially unaltered during a considerable period of time. A study of locomotive history will reveal that the normal progress of railway mechanical engineering has permitted extremely few standardization programs to survive more than six or seven years without drastic modification. In some instances, standard locomotives have become obsolete within five years after completion of the first drawings. Sooner or later, those railroads which have adhered most rigidly to standardized motive power have found that their locomotive stock has failed to keep pace with that of other companies who have pursued a free course.

Present-day advocates of standardization place great emphasis upon results achieved in Germany during recent years. The program in effect in that country since 1925 is the culmination of a series of standardization schemes, the first of which was adopted in Prussia in 1876. The existence of these earlier schemes did not prevent the accumulation of 210 different classes of locomotives on the German railways by 1920. The present work has been carried out with characteristic Teutonic thoroughness and, incidentally, with much blaring of trumpets. Like everything else so far promoted by the Third Reich, it is an "unqualified success."

But if one studies the German locomotives very closely, he soon discovers an unusual amount of elasticity in the present standardization program. A half dozen new types have already been added to the sixteen originally planned for use on the standard gauge lines. The details of individual types have also been considerably altered from time to time. Consider, for example, the 4-6-2 type fast passenger locomotives. Between 1925 and 1938, no less than twelve different groups of "Pacific" type locomotives were built for the Reichsbahn. Each group consisted of anywhere from ten to one hundred locomotives. Most of them bore a close superficial resemblance to one another, but there were fundamental differences in cylinder arrangement and internal boiler design, and many vital parts were not interchangeable. Few will need to be reminded that maximum interchangeability of parts is the keystone of any standardization plan.

Whether or not standard locomotives should be generally adopted in America would appear to be a relatively simple problem. Only one question need be asked. Has the orthodox steam locomotive finally reached the point where no further improvement in design or construction is possible? If the answer is in the affirmative, then the time is ripe for a comprehensive standardization program. If, on the other hand, it is agreed that the steam locomotive has not yet attained finality, then it is still possible to correct a motive power situation which has been aptly described as a "riot of individuality," without simultaneously stifling the march of progress. The much discussed consolidation of American railroads into a small number of large systems, each with its own independent, able and wide-awake mechanical department, would result in the purchase of locomotives in far larger groups than at present, with a consequent ultimate reduction in the number of designs in service throughout the country. At the same time, the element of competition which has assisted in the development of the best motive power in the world would be fully retained.

The foregoing discussion has been confined entirely to the steam locomotive. Other forms of motive power have been purposely omitted, because it is felt that no informed individual would seriously propose the standardization of either electric or Diesel locomotives at this stage of their evolution.

W. T. Hoecker.

First Bead in Vertical Vee—A Difference of Opinion

To the Editor:

The November issue of the *Railway Mechanical Engineer* has on page 491 an answer to a question about the first bead in a vertical vee weld using a coated electrode.

It is my belief that the answer is very misleading. There is no reason, except lack of knowledge about how to manipulate, why the first bead in such a weld should look like a "bunch of grapes" or have laps and slag inclusions. It is perfectly possible to make a completely sound weld "vertical-up" with a flat smooth face by using the proper electrode and procedure.

A "vertical-down" bead will usually have a very good appearance but if it does not have holes it will be unusual; but what is worse, it will not have proper penetration. Even a skillful welder who can make an excellent "vertical-up" bead will not obtain comparable penetration in a down bead. We feel that penetration is extremely important and this is especially true of the first bead.

We have made a good many tests in our laboratory with "vertical-down" beads using many types of electrodes and we have obtained neither satisfactory penetration nor soundness. It is practically impossible to eliminate pinholes in this procedure.

The only reason for commenting on this item is that we think unsatisfactory welds will result from the use of "vertical-down" beads. Practices that lead to unsatisfactory results may lead to more restrictions on welding and there are already too many restrictions that cannot be justified.

I would suggest that the one who asked for the information have his foreman request the company furnishing the electrode he is using to send an instructor to show him how to make a "vertical-up" bead. All electrode manufacturers have such men available and normally are anxious to cooperate.

L. E. Grant,
Metallurgical and welding engineer
C. M. St. P. & P.

Improved Method for Checking

Alignment of Running Gear*

Part I†

The alignment of driving wheels, engine trucks and trailer trucks is one of the most important functions of the back shop and has a profound effect on the availability and maintenance cost of the locomotive throughout its life. These parts are basic elements of the locomotive and its successful operation is dependent upon their proper adjustment and condition.

Improper alignment results in many chronic defects which increase the time the locomotive is held out of service for repairs and which increase maintenance cost. Some of the most common defects resulting directly from improper alignment are: Locomotive does not track evenly and runs to one side causing uneven wear of tires and wheel flanges; chronic overheating of main journals, crank-pin bearings and truck journals; excessive and uneven wear of hub liners, hub faces and journal bearings and excessive wear on crank pins and rod bushings.

There are other defects which may result indirectly from improper alignment for which the causes are not always readily apparent and are often difficult to determine.

The main frames are the foundation of the locomotive and it is extremely important that they be square within reasonable limits and that any slight irregularities be known and compensated for in the alignment of the drivers and trucks. Such conditions can be checked and corrections made only in the backshop where tools, facilities and time are available for performing the work in a proper and accurate manner.

There are several methods in use for checking alignment and squaring frames, practically all of which have some good points. The practice described here includes the best features of the several methods, is applicable to all types of modern locomotives and is as simple as possible consistent with producing accurate results.

Method of Procedure

The work of aligning driving wheels, engine and trailer trucks and laying off shoes and wedges may be classified into eight principal operations as follows: square and check the main frames for alignment; check the alignment of cylinders in relation to main frames; locate and square main centers; lay off shoes and wedges; check driver lateral to determine the thickness of the hub liners on the boxes; square and check the alignment of the engine truck; square and check the alignment of the trailer truck and tram the locomotive after the drivers are applied and make final check of alignment of axles, wheel centers and tires.

If these operations are correctly performed and the necessary corrections made for irregularities found, the locomotive will be properly lined and squared when it leaves the shop and should be free of the troubles resulting from improper alignment.

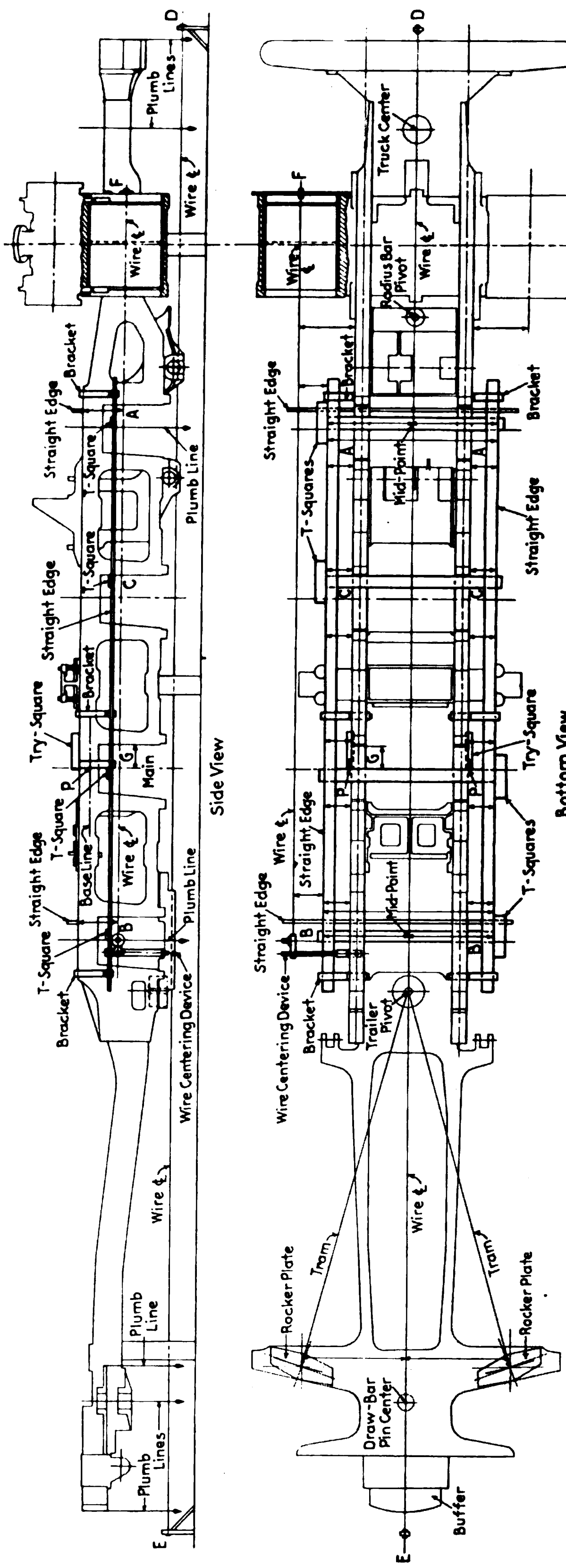


Fig. 1—Arrangement of the various tools used in checking locomotive running gear

* Abstract of a report presented at the annual meeting of the Locomotive Maintenance Officers' Association at the Hotel Sherman, Chicago, September 23-24, 1941.
† Part II will appear in the January issue.

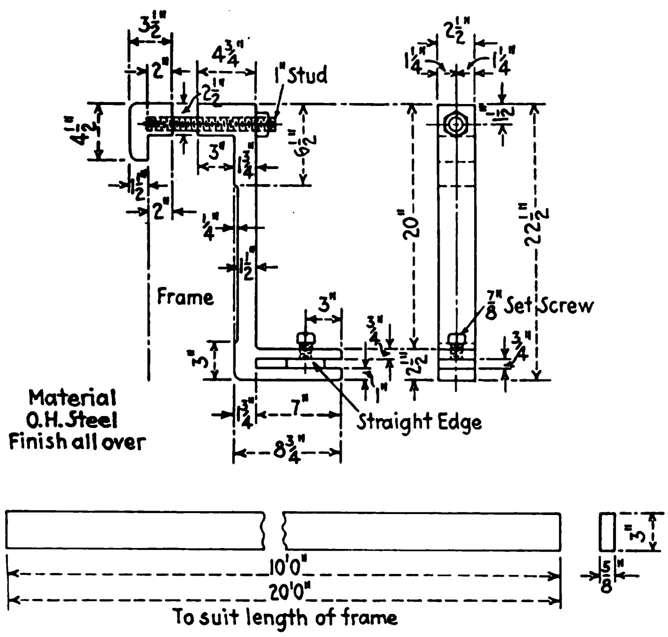


Fig. 2—Bracket for supporting the straight edge and a detail of the long straight edge

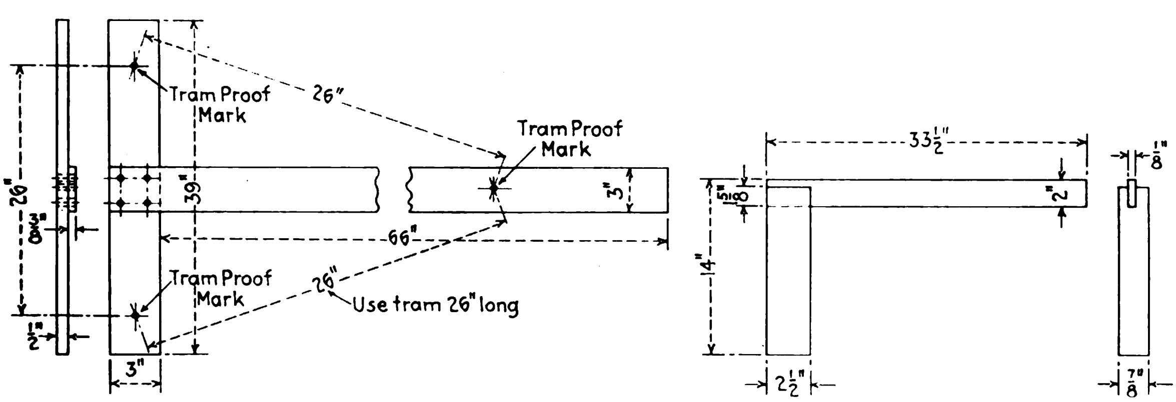


Fig. 3—T-square and try-square

Square and Checking Main Frames

The proper basis to work from in checking and aligning the main frames is the mean center line of the frames themselves since they are the foundation of the locomotive and contain the rigid wheel base. This basis is more satisfactory than others, including the fishtail tram or center lines through cylinders extended to the rear pedestals, as, with modern locomotives having a long wheel base and heavy frames, the chances of error are less and the results obtained are therefore more accurate.

Preparatory to checking, the main frames should be assembled complete with cylinders, cross-ties, center casting, rear-end cradle, etc. They should be set level and supported in such a manner that the pedestal jaws are not sprung when the pedestal binders are removed. All frame surfaces at the pedestals should be clean and smooth as these are the primary working surfaces from which the check is made. The pedestal binders should then be fitted and applied.

The checking should be done from two long straight edges set parallel to the frames on each side as shown in Fig. 1. They should be supported by suitable brackets in sufficient number to prevent sagging. A detail of the bracket used is shown in Fig. 2. It is clamped to the top rail of the frame, bearing on the top and outside faces of that member, and is designed to allow lateral adjustment of the straight edge.

The straight edges are set parallel to the frame on each side by means of spacer, or gauge, blocks at points *A* and *B* (Fig. 1) and are then clamped in the brackets. Next, measure distance between the outside edges of the two straight edges at *A* and *B*. If the distances are equal the frames are parallel.

If these distances are not equal, set each straight edge in at the wide end, an amount equal to one half the difference, so that the distances are equal. The straight edges are then parallel and are parallel to the mean center line of the frames. This operation is especially important.

Measure the distance from the outside edge of each straight edge to the outside face of the fame at each pedestal jaw. If all of these measurements on one side are equal, the frame is straight on that side. If they are not equal the frame is bowed, or sprung. These measurements are used to determine the thickness of the driving box hub liners required to obtain the proper alignment of driving wheels.

To check the frames for squareness, set the head of a long T-square against the outside edge of one straight edge with the blade extending through the pedestal to

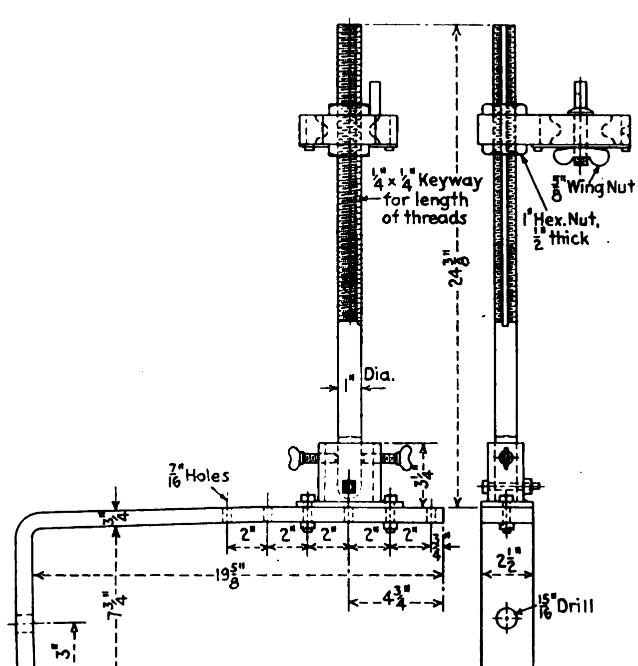


Fig. 4—Support for wire lines

the straight edge on the opposite side, as shown at *C* (Fig. 1). Move the T-square against the faces of the pedestal jaws. The frames are square if these faces bear evenly against the edge of the T-square across their entire width. Reverse the T-square and re-check. The check should be made at each pedestal.

The alignment of the engine-truck center, radius-bar pivot, trailer-truck pivot, trailer-truck rocker plates, draw-bar pin hole and the rear buffer casting should be checked by means of a wire, *D-E,* shown in the side view of Fig. 1, stretched taut below the frames, on the center line. The wire should be located on the center line of the frames midway between the outside edges of the straight edges at *A* and *B*. The location of this wire is accomplished by means of a plumb line from a T-square across the straight edges at *A* and *B*. The plumb line is set to the mid-point on the T-square, extending downward to the wire. In this case, particular care should be taken to see that the frames are cross leveled and that the T-square, across the straight edges is level.

The alignment of the various points mentioned above should then be checked with reference to the wire center line by means of plumb lines. This will also provide for checking the alignment of the front extension and the rear frame cradle. If the centers of these points, such as the engine- and trailer-truck centers, draw-bar pin hole, rear buffer casting, etc., coincide closely with the wire center line, they are in correct alignment. If not, they are off center or the frames are sprung.

The location of the trailer rocker plates should be checked by marking their centers and checking the distance to the wire center line, which should be equal on both sides. Check the distance between the rocker-plate centers which should closely equal the drawing dimension. The tram distance between the trailer pivot center and the centers of the rocker plates, as shown, should be equal on both sides and should be the same as the drawing dimension.

It will be noted that, in the method described, all checking is done with reference to the outside edges of the long straight edges which are set parallel to the mean center line of the main frame. This common basis for all checking operations reduces the chances of error and provides more accurate results than is possible when different bases are used for the various operations.

Details of the long straight edges and the T-square used in this operation are shown in Fig. 2 and Fig. 3.

Checking Alignment of Cylinders

It is important that the cylinders be in proper alignment relative to the main frames. The center lines of the cylinders should be reasonably parallel to the center line of the frames and the correct distance therefrom.

This should be checked by running a wire center line, *F-B,* (bottom view, Fig. 1) through the bore of the cylinder and extending to the rear pedestal. Attachment at the rear pedestal should be made by means of a wire centering device, the detail of which is shown in Fig. 4, clamped to the binder.

The lateral alignment of the cylinder bore is checked by measuring the distance of the wire center line from the outside edge of the long straight edges at *A* and *B* and from the outside face of the frame at *A*. The former distance should be equal at both locations and the latter should agree with drawing dimensions within reasonable limits. It is important that the cylinder center lines be parallel to the straight edges which are parallel to the center line of the frames, as the straight edges are used in locating and squaring the main centers.

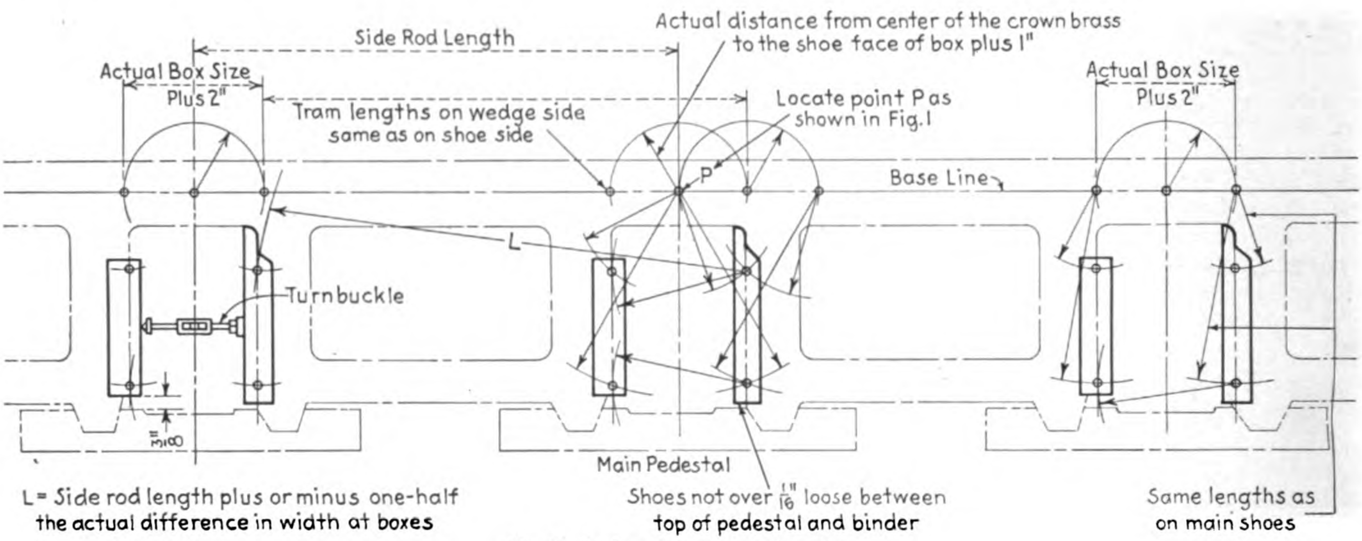


Fig. 5—Laying off shoes and wedges

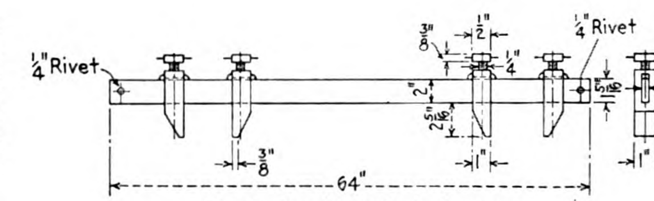


Fig. 6—Details of the back-gage

The vertical alignment of the cylinder bore is checked by placing straight edges across the top of the frames at *A* and *B* and measuring the distance between the lower edge of the straight edge and the wire center line at each location. These distances should be nearly equal and should also agree with the drawing dimension.

Locating and Squaring Main Centers

The main centers are the points from which all other driving box centers are located and from which the shoes and wedges are laid off. This controls the alignment of the driving wheels. Therefore, the proper location of the main centers and their squaring with the main frames and cylinder center lines is very important.

To perform this operation, set a T-square across the long straight edges, through the main pedestals, as shown

at G (Fig. 1). The front edge of the T-square should be set back from the shoe face of the pedestal a distance equal to the thickness of the shoe plus one half the width of the driving box, as shown on the box drawing.

If the frames are square, and with the head of the T-square set tight against the outside edge of the long straight edge, the distance from the front edge of the T-square to the pedestal face will be the same on both sides of the frame. If the frames are not square and the T-square is set to the correct distance from the pedestal face on one side, the distance on the opposite side will not be equal. In this case, move the T-square forward or back, as the case may be, one half the difference, so that this distance on both sides is equal, and clamp the T-square to the long straight edges with C-clamps.

Scribe a base line on the outside of the frame above the main pedestal a convenient distance from the top, as shown in Fig. 1. Set a try-square (shown at the right in Fig. 3) with one leg on top of the frame and the other leg extending downward with one edge against the front edge of the T-square. Where this edge of the try-square crosses the base line, prick-punch a point P. This is the correct location of the vertical center line of the main boxes, properly squared with the mean center line of the main frames and cylinders. Reverse the T-square and re-check.

Laying Off Shoes and Wedges

In laying off shoes and wedges the vertical center lines of the driving boxes, other than the main, are located from the main centers P (Fig. 1), which have previously been properly located and squared. This is done by first extending the base line through point P to all pedestals and then locating all other centers from P by means of trams set to actual side-rod length, which center points are then marked on the base line with a prick-punch, as shown in Fig. 5.

Apply the shoes and wedges solidly against the pedestal faces, holding them in place by means of turnbuckles. Then lay off main shoes and wedges from the main center point P, as shown in Fig. 5. When this has been done the other shoes and wedges are laid off from the centers marked on the base line and from the main shoe and wedge points as shown.

The points marked on the outside faces of the shoes and wedges should be transferred to the inside faces by a back gage, the details of which are shown in Fig. 6.

After machining, apply all shoes and wedges to the pedestals to check the box fit and see that the shoe and wedge faces are parallel and in line with those of the opposite side of the frame.

Questions and Answers On Welding Practices

(The material in this department is for the assistance of those who are interested in, or wish help on problems relating to welding practices as applied to locomotive and car maintenance. The department is open to any person who cares to submit problems for solution. All communications should bear the name and address of the writer, whose identity will not be disclosed when request is made to that effect.)

Applying Heavy Deposits On First Pass

Q.—When brazing pistons, link blocks and many other parts that require a depth of bronze deposit I find I have to make several passes to reach the desired thickness. Is there a way to gain this thickness on the first pass?

A.—The easiest way to acquire a heavy deposit of bronze on such parts is to place the part to be brazed in such a manner that it presents an angle or side-hill effect to the welder—about a 45-deg. angle is sufficient. When brazing link blocks or similar parts that are to be laid out after brazing, it is advantageous to have a square edge on the bronze deposit. Brazing a ½-in. wide strip up both sides of the part first will aid in doing this and also makes it simpler to fill in the center to the desired depth.

Rebuilding Brake Beam Ends

Q.—It is standard practice in many shops to rebuild the ends of brake beams, brake hangers, and other worn parts. Can this be done so that subsequent machining or filing is not needed?

A.—Brake hangers, brake beams and other similar parts can be rebuilt so that no machining is needed. Before attempting these operations secure a bushing similar to the one that will be used on the part. There is usually a shoulder worn on brake-hanger posts and the ends of the brake beams that will give the welder a fair idea of the amount of metal needed to bring the part back to size. When an area some 2 in. sq. is welded slightly above the required amount, the welder hammers this until the test bushing slips over easily. This same process is carried out until the part is completely welded and hammered to size.

Holding the Metal in A Heavy Weld

Q.—Some welders have trouble holding bronze in the V when brazing on heavy work such as cylinders or locomotive frames. What can they do to improve their technique in an application of this kind?

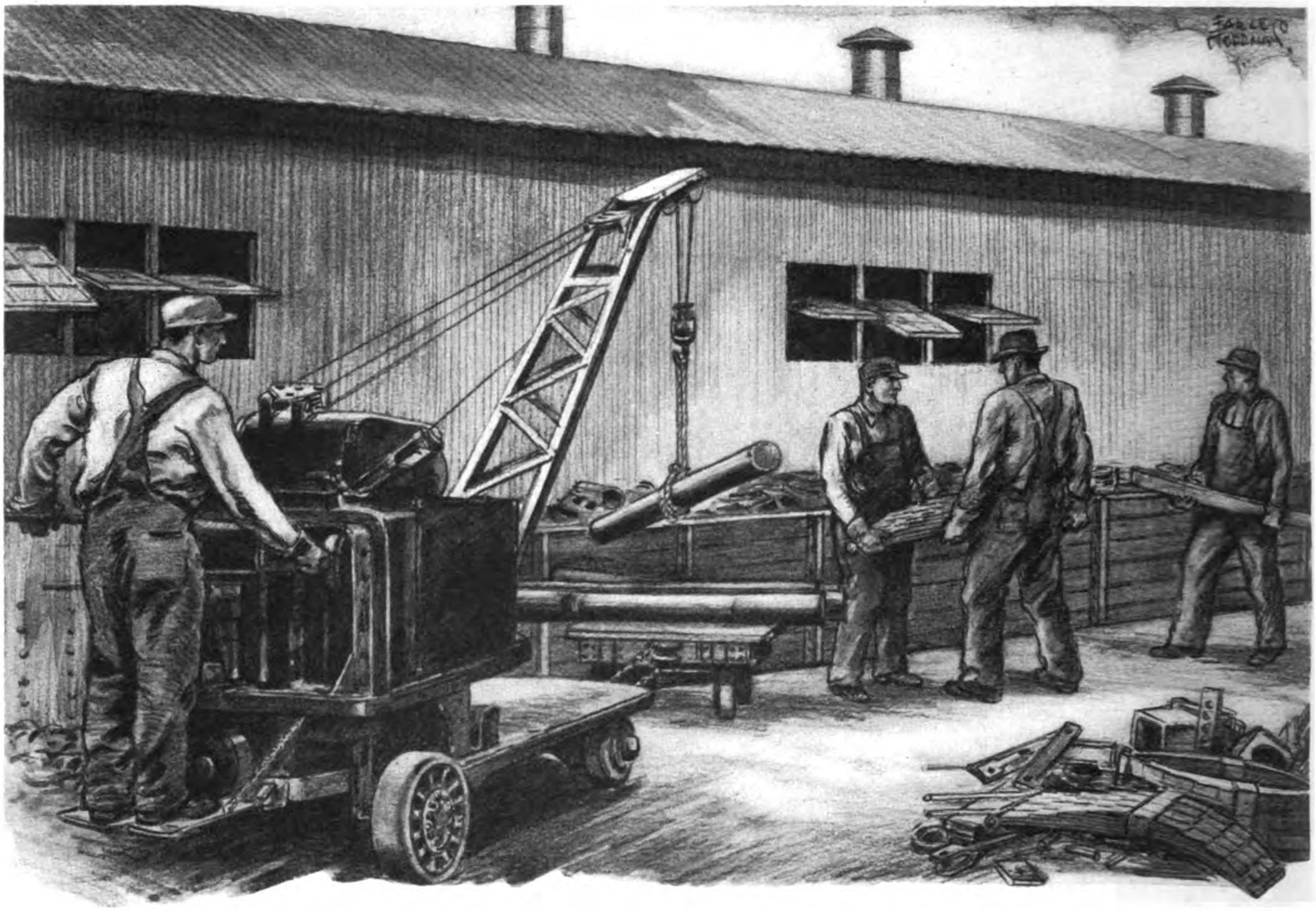
A.—The ability to hold large puddles of molten bronze in the V when brazing on heavy work comes with years of experience. This seems to be the only way of developing this aptitude.

A substitute method can be used. A number of strips of tank steel are cut 3/16 in. thick by ¾ in. wide and of a length suitable to reach to a point at least an inch on each side of the V. The pieces are bent to conform with the outside of the desired reinforcement. After the bronze weld is started, an assistant holds one of the strips across the V, the welder then fills the dam full and applies another strip, this one is filled and this carried on until the weld is complete. This method controls the bronze and keeps a quantity of expensive bronze off the floor.

Renewing Worn Lugs on Driving-Box Cellars

Q.—What method of repair do you suggest for worn and broken out grease cellar lugs on locomotive driving boxes?

A.—There are several ways of repairing worn out lugs on driving boxes. A simple and effective method is by cutting the worn lug through with the cutting torch—if the lug is worn through this is not needed. Place two narrow strips of asbestos paper in the bottom of the cellar pin hold and insert a new cellar pin. Heat one side of the remaining lug with the welding torch and hammer it over the cellar pin. The other side of the same lug is treated in a like manner. All that is needed is to build the lug back to the original thickness with a good grade of steel rod. When the welding is completed hammer the lug into shape and strike the cellar pin a couple of good sharp blows, the asbestos paper will crumble and free the cellar pin so that it can be removed easily. This method leaves the right amount of clearance for the cellar pin.



Jim Evans, the roundhouse foreman, put a gang of laborers at work gathering and loading scrap

GOLD Is Where You Find It

by **Walt Wyre**

IT started before Japan snagged her sheepskin and let the wolf hair show. The United States was sending airplanes to China and scrap iron to Japan to shoot them down. Junk dealers became so busy loading scrap they didn't have time to go get their relief checks. All of them bought new automobiles and some of them found it more profitable to bale their old jalopies along with other compressed cars than to trade them in. Maybe at that they are less dangerous when molded into shells than running around on the highways.

Railroads took advantage of the booming market and started loading scrap fast as it could be gathered and gondolas spotted. Everything that looked like scrap and some that didn't was loaded and shipped. In some places, hot wells were dredged for "killed" pins, bushings, and other metal that might be found in them.

The S. P. & W. was no exception. At Plainville, as at other points on the railroad, Jim Evans the roundhouse foreman, put a gang of laborers at work gathering and loading scrap and kept them at it until even the division storekeeper couldn't have found enough scrap metal to make a sinker for a fishing line.

In the meantime, England was yelling for more guns, more airplanes, more ships, and more of everything else that might be used to convince Hitler that writing a book is one thing and making boasts come true another. The U. S. decided we might need a couple of guns and planes, too. The result was that storekeepers for once had an airtight alibi for material shortage.

One day Jim Evans was in the roundhouse office trying to decide whether to use the 5094, that had a badly cracked cylinder casting, or the 5087, that was long overdue for the drop-pit, to pull an eighteen-car soldier train, when machinist Jenkins came into the office. Jenkins does the machinist welding in the shop at Plainville.

"Say, Mr. Evans," the machinist said. "We haven't got enough bronze to build up all of the driving boxes for the 5093."

"Did you try the storeroom?" Evans asked.

"Yes, sir," Jenkins replied. "I got all they had. There's still only about half enough. Do you want me to start on them?"

"Just a minute." Evans rose and walked over to the roundhouse clerk's desk. "Tell the despatcher we'll use the 5094 on that soldier train. Now, Jenkins, let's go see what we can do about those driving boxes."

The foreman and machinist walked through the roundhouse and to the welding booth in the machine shop. "That's all of the bronze rod there is." Jenkins pointed to a pile of half-inch square bronze electrodes.

Evans shook his head and they both stood looking at the stack of electrodes. No argument about it, there was only about half enough to do the job.

"Well," Evans said, "we might cut some horse shoes out of boiler steel and weld them on the hub ends of the driving boxes. That would save enough bronze."

"Yeah," Jenkins commented, "if we had the boiler steel."

"Guess you are right," Evans said. "We haven't even got steel for the boiler side sheets yet. Say, that gives me an idea! Let's go to the roundhouse."

The two men walked into the roundhouse where the 5093 stood looking very much torn down without drivers. The two badly corroded side sheets were lying on the floor beside the trailer wheels.

"That should do it," the foreman said half to himself.

"You mean use them?" Jenkins asked.

"Why not? The staybolt holes make them so much the better. You can weld right through the holes on to the driving box, then build up over the steel with bronze for a bearing surface. Let's try it."

In the afternoon Evans went to the machine shop to see how Jenkins was getting along and found the scheme working nicely. Not only was he saving bronze but also doing the job in less time than usual.

From the machine shop Evans went to the storeroom to see if some hoped-for material, including four crosshead gibs, had arrived. It hadn't, and the foreman left, talking to himself. He stopped in the machine shop to look at the badly worn gibs. He knew by experience that building them up with babbitt wasn't usually satisfactory. It just wouldn't stay in.

Suddenly he turned and walked over to the welding booth. "Say, while we are experimenting, let's try something else," he said. "Come over here."

They walked over to where the gibs lay and squatted down on the floor as though getting ready to start a crap game. "Look here,"—the foreman pointed to a gib —"build up each end with acetylene bronze to make a sort of dam, then weld a piece of front end screen in the bottom of the gib and have the coppersmith fill up between bronze with babbitt. The front end screen will reinforce the babbitt. Then we'll plane it to fit."

"Looks all right," the machinist commented.

That idea worked even better than Evans had thought. The gibs thus repaired ran better, particularly on worn guides, than did new ones. Evans was well pleased with himself when he left the machine shop and went to the roundhouse office, but John Harris, the roundhouse clerk, smothered the foreman's good humor with a verbal blanket soaked with ice water.

"Despatcher just called," Harris said. "He wants an engine quick to send to pull the soldier train. The right cylinder fell off the 5094 and scattered all over the right of way."

"I've been trying to get a cylinder casting for over two months," Evans said dolefully. "Tell the despatcher we'll send the 5087."

After Evans had arranged for the 5087 to leave, he went to the storeroom to find out if there was any hope of getting a cylinder casting soon. There wasn't, and Evans left feeling like he would have to stand on tip-toe to look a snake in the eye.

Next day Evans was talking to H. H. Carter, master mechanic of the Plains Division, about the situation.

"There's no use trying to rush a new cylinder casting," Carter said. "There's an old casting off the 5091 at Sanford. It's pretty badly cracked. If you can figure out any way to patch it, we might use it on the 5094. I'll wire them to ship it to us."

After Evans figured out a method of building up the hub ends of the driving boxes for the 5093, it wasn't long until they were ready to put the wheels under the engine. Steel for the side sheets arrived at about the same time. Everything was going along very nicely until they were ready to put the bolts in the crank arm and discovered that there were no bolts and no suitable material at hand for making them. The way it turned out, the stores department did Evans a good turn by not having the bolts. If they had, the foreman might not now have nearly two hundred feet of good quality round steel 1¾ inches in diameter. Evans wasn't looking for crank arm bolts when he stumbled on the steel. He was looking for something to use for making a shaft for a 5 hp. motor. The motor bearing had been run dry of oil, causing the bearing to burn and score the shaft. They had new bearings for the motor, but if the shaft was turned the bearings wouldn't fit and it was a case of making either a bearing or shaft. The foreman, hopeful as a prospector looking for gold, went to the water service shop and found the shop locked.

"The water service men are at the north well," a laborer told Evans.

Still hopeful, the foreman walked up to the wheel house and found two water service men and a helper installing a new pump in the well. He asked one of them about material for the motor shaft.

"No," the water service man replied, "I don't know where you could find anything like that if the storeroom hasn't got it. We haven't got anything in the water service shop."

Evans turned to leave and suddenly stopped like a bird dog that had unexpectedly discovered a covey of quail. "What's that?" Evans pointed to a pile of round steel shafting stacked against the wall.

"That's the shaft out of the old pump," the water service man said.

"What are you going to do with it?" Evans asked.

"Oh, scrap it, I guess," the water service man said.

"Not if I can help it." Evans knelt and measured the shaft. "One and three-quarter inches—just right for the motor shaft and it'll make dandy crank arm bolts," he added. Except for worn places where the bearings had worked, the shaft was good as new.

In addition to using some of it for the motor shaft and crank arm bolts, it was also used for making two valve gear pins that day and since has been a source of supply for some needed part almost every day. Evans had it hauled down to the machine shop and stacked against the wall by the hack-saw.

The second-hand cylinder casting and the engine that needed it reached the roundhouse at Plainville the same day and it was difficult for Evans to decide which looked the worst. There were two long, deep cracks in the back of the cylinder casting. As for the 5094, she had not let loose of her right cylinder without a struggle, as bent main rod and valve gear testified. A guide yoke end was broken.

Even after the cylinder casting was unloaded, Evans walked around it two or three times trying to decide whether to try to repair and use it or not. If there had been any immediate hopes of getting a new one there

would have been no question. Reluctantly he decided to have a try at it.

The first thing he did was to have a mechanic chip out the cracks. "And be sure and chip them out deep enough to cut out all of the crack," he told the mechanic.

The next thing was a furnace for preheating the casting and keeping it hot while welding it. The furnace was built of fire-brick and covered over with some scrap boiler steel with asbestos on top of the metal. Two steel doors were made for the welder to work through. Natural gas was used to heat the casting, one burner at the bottom on each side of the furnace.

Before beginning to weld, the casting was almost hot enough to melt the bronze that was used for the job. The welder knew his stuff with an acetylene torch and did a good job of tinning the bronze to the casting and filling the V without blow holes or honeycomb spots. He built it up well above the adjoining surface so that the bronze could be chipped off and ground flush and smooth. When the welding was finished, the furnace doors were closed and the casting allowed to cool gradually.

Welding the casting was only part of the job; putting it on was something else again. Evans, by this time accustomed to encountering shortage of material, wasn't surprised when he found that there were no bolts at hand for applying the cylinder casting. This time he found the solution at the car department. An old style baggage car that had been in a wreck was being scrapped. The truss rods supplied material for making the round head 1½-inch splice bolts and 1¼-inch saddle bolts and left some material for a future emergency.

Fitting and bolting the cylinder casting was a considerable job, but the engine lacked a lot of being ready to run when that was done. The blacksmith did a nice job of straightening the main rod and valve gear. The broken guide yoke was welded and reenforced with a piece of steel which make it stronger than ever.

Evans had done so much contriving and using what had heretofore been called scrap material that every bit of metal became a potential source of material until proven otherwise. Steel from scrapped fire pans was used as liners on the shoe and wedge face of driving boxes, and it's been months since a new piece of steel has been used for tank patches. Floating liners are saved and welded on top of shoes. Knuckle pin keys are made from old valve stems. Bronze hub liners from trailers, and engine trucks that are worn thin are made to give additional service by welding sheet steel on the backs of the liners. Knuckle pins are made from old piston rods and even old arch bars are brought up from the car department to replace new material of a like size.

Steel that might be crystallized from fatigue is given a new lease on life by normalizing and heat treating which is done in a gas fired furnace. Bolts and nuts that would have once been thrown away are turned in to the tool room man who runs a tap through the nuts and a die over the bolts of all that are suitable to use again. By doing this in his spare time there is practically no labor cost.

The master mechanic has passed some of the ideas along to foremen at other points on the Plains Division and they are making use of them to conserve material and to relieve the burden on machine tools needed for the defense program.

All of this didn't come easy, and Jim Evans increased the current consumption of aspirin. Practice brings proficiency, it is said, and Evans has certainly had lots of practice figuring out how, figuratively speaking, to make bricks without straw and in some cases with very little mud.

Then, too, sometimes the necessity for using material may be avoided by proper methods, like when the left trailer wheel on the 5085 was noticed to be cutting. The 5085 is a roller bearing engine, including the trailers, and it was apparently lined perfectly, but the left wheel continued to cut while the right wheel did not. It was not cut badly, but in just one or two more trips the wheels would have been removed and turned. Evans caught the condition before it was cut enough to take the gauge. He ran the engine over the drop-pit, dropped the trailer wheels and turned them around, figuring that the right wheel which was on the left side after the wheels had been turned around would perhaps start cutting, but the one on the other side would stop cutting. That is exactly what happened, except after the wheels were turned around the cutting stopped almost entirely and the trailers will apparently run just as far as they would if they had been turned in the wheel lathe.

Evans has been pretty lucky and maybe there's not so much luck to it either, keeping things going, but every once in a while, almost every day in fact, he runs up against a proposition that seems impossible to handle, and some of them are. That almost happened with the 5080.

Evans was figuring on using the engine next day and everything was going along about as well as could be expected. The foreman walked through the roundhouse and out to the machine shop and noticed the cross-head gibs all set up to be babbitted, but apparently no one was working on them. Evans went to find the coppersmith that was supposed to be doing the job. He found the coppersmith doing some pipe work on another engine.

"How you coming on the cross-head gibs for the 5080?" Evans asked.

"Haven't got any babbitt," the coppersmith replied.

"None in the storeroom," Evans remarked rather than asked.

"Not an ounce, and I've dug up every bit I can find anywhere. The last job I did I had to scrape the pot, then was a little short."

"Let's go see what we can find," Evans said.

It seemed that search as they would, there was no babbitt anywhere. At the water service shop where Evans had hoped to find some of the metal the water service man said he was badly in need of babbitt himself and was figuring on going to the roundhouse in search of some.

"Maybe we might find enough car brasses at the car department that we could melt the babbitt off," the coppersmith suggested.

"That might be an idea," Evans agreed. "You go on back and finish the job you were working on. I'll go down to the car department."

"No, since the defense program started we send our old brasses in almost as fast as we take them off and we haven't got any babbitt. We don't run any bearings here, you know."

Evans stopped at the storeroom on the way back and asked when and if some babbitt was expected. The reply was "next week, maybe."

The foreman went to the machine shop just about ready to give up. He walked around in the machine shop, then out the west door where there is a platform built of old channel iron laid on the ground. They have a portable gas burner there that is used for heating, melting babbitt off, boxes, etc. For some time the S. P. & W. babbitted the hub end of driving boxes by fitting a piece of flat iron around the end of the box and fitting it with babbitt, then removing the piece of iron. Each time a box was rebabbitted the old metal was melted off.

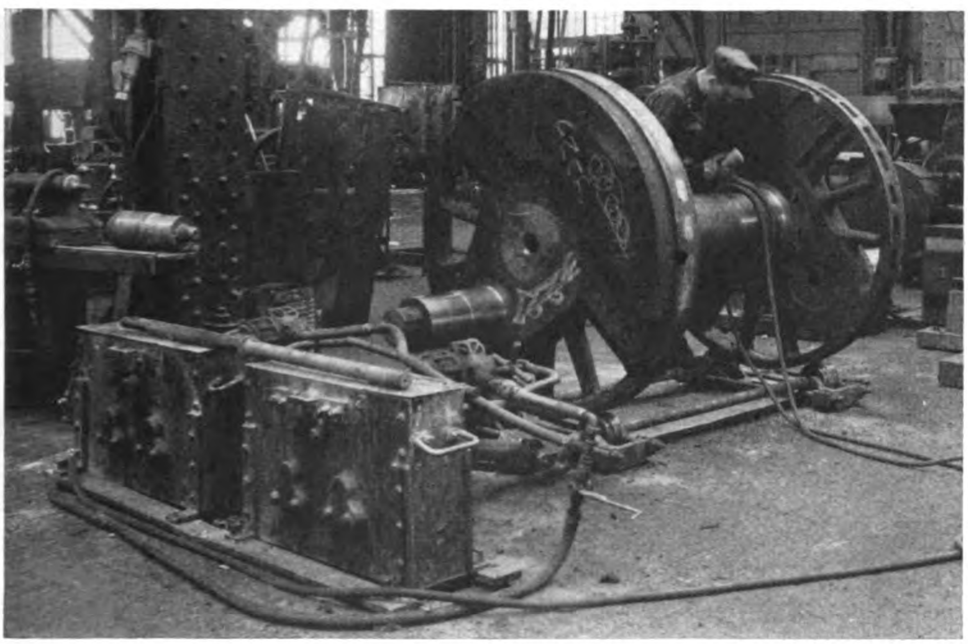
(*Concluded on page 536*)

Convenient Equipment For Magnaflux Testing

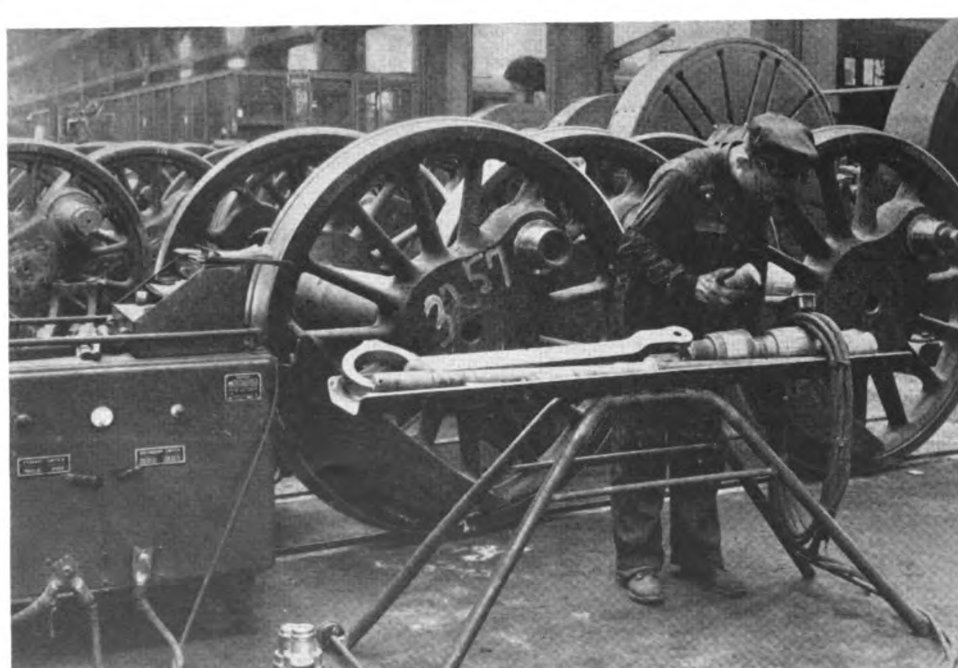
Two devices for the convenient Magnafluxing of locomotive parts are shown in the illustrations, one consisting of a set of rolls used in testing driving axles and the other a convenient portable steel tray or stand for use in testing small parts, such as valve rods, piston rods, wrist pins, knuckle pins. etc. In view of the necessity for more careful and thorough checking of an increasing number of locomotive parts by this method, any devices such as those illustrated and now in use at the Atchison, Topeka & Santa Fe shops, Albuquerque, N. M., demontrate their value in a very practical way.

Referring to the view in which a driving axle is being Magnafluxed it will be noticed that the mounted wheels and axle are resting on a set of old valve-setting rolls which are air-operated through reduction gears and two drive shafts to the small rolls which support the driving wheels. Usually about three coils of wire are looped around the axle and a heavy electric current from the Magnaflux machine creates a magnetic field in the axle which causes the powder to show up clearly any surface defects or potential fractures. Inasmuch as the axle has to be examined minutely throughout its entire length and circumference, the valve-setting rolls enable this work to be done with the operator standing in one position and without the necessity of rolling the wheels and moving the Magnaflux wire along the shop floor.

For Magnafluxing the short rods and locomotive parts mentioned, the pipe-supported tray or stand is exceptionally convenient and a great time saver. This stand consists of a piece of ¼-in. tank steel, 68 in. long by 11 in. wide, flanged on either side enough to keep the small locomotive parts from rolling off and welded to a sup-



Old valve-setting rolls provide a convenient means of revolving locomotive driving wheels while Magnafluxing the axles



Portable steel tray or stand which affords a quick and convenient way of testing small locomotive parts by the Magnaflux method

porting framework of 1-in. steel pipe, bent and braced to the shape shown. The height of the stand is 32 in. and two legs of the pipe are equipped with small rollers so that by lifting the other two legs, the device may be readily moved about the shop. Not only does this device save labor and time in handing the small locomotive parts while being tested, but it also saves Magnaflux powder which drops to the tray and can be collected for re-use after each group of locomotive parts is tested.

Locomotive Boiler Questions and Answers

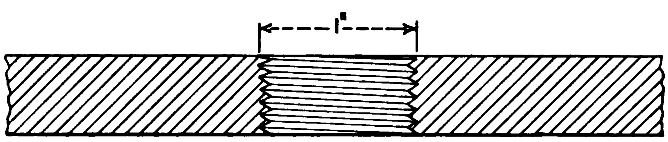
By George M. Davies

(This department is for the help of those who desire assistance on locomotive boiler problems. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless special permission is given to do so. Our readers in the boiler shop are invited to submit their problems for solution.)

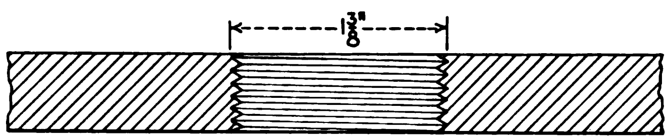
Repairing Tapped Holes In Boiler Sheets

Q.—Is it satisfactory to repair the tapped holes in a wrapper sheet for the rigid taper-head staybolts of a locomotive boiler by plugging them with electric weld and drilling and retapping new holes?—M. Z.

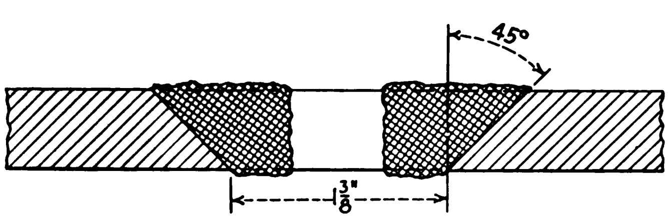
A.—When the rigid taper-head staybolt threads in the wrapper sheet are worn and need renewing, the sheets should be retapped for oversize staybolts. When the maximum oversize thread has been used, the holes may then be welded and retapped to their original size, in the manner illustrated, provided no cracks, radiating from the staybolt holes, are found in the wrapper sheet.



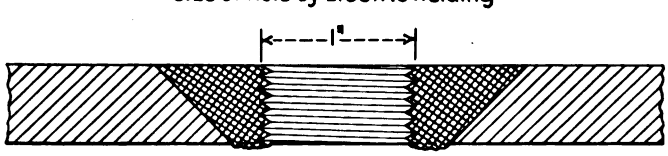
Initial Size Tap



Maximum Oversize Tap



Method of Countersinking and Reducing Size of Hole by Electric Welding



Finished Weld and Hole Retapped to Initial Size

The manner in which tapped holes in boiler sheets may be renewed by welding

Heat Losses Due to Scale

Q.—When a locomotive boiler tube becomes coated with scale, what heat losses are incurred due to the scale?—F. I. D.

A.—Professor Schmidt of the University of Illinois has given the following table for heat losses in boiler tubes due to various thickness of scale. There have been various other values given but these figures are considered authoritative by a good many engineers.

	Per Cent Loss of Heat		
Thickness of scale, in.	Soft Carbonates	Hard Carbonates	Hard Sulphates
1/50	3.5	5.25	3.0
1/32	7.0	8.3	6.0
1/25	8.0	9.9	9.0
1/20	10.0	11.25	11.0
1/16	12.5	12.6	12.6
1/11	15.0	14.3	14.3
1/9	...	16.0	16.0

Carbon Steel Rivets In Nickel Steel Sheets

Q.—Would the efficiency of the longitudinal seam of a nickel-steel boiler be affected by replacing the nickel-steel rivets with carbon-steel rivets?—F. P. S.

A.—The effect of replacing nickel-steel rivets with carbon-steel rivets in the longitudinal seam of a nickel-steel boiler would be to reduce the rivet shear from 60,000 lb. to 44,000 lb. in single shear and from 120,000 lb. to 88,000 lb. in double shear. To determine the actual effect on the efficiency of a given seam, the seam should be calculated using both values for single and double shear of the rivets. By calculating a typical example of a quadruple riveted butt and double strap seam, it shows that the efficiency of the seam is reduced from 91.4 per cent to 85.9 per cent when carbon-steel rivets are used in place of nickel-steel rivets.

Gold Is Where You Find It

(Continued from page 534)

Evans looked around over the platform, but every scrap of the metal had been removed. The only piece he saw was a little sticking up in a crack between two of the channel irons. Every little bit would help. He stooped and took hold of the finger of babbitt. It wouldn't budge. He pulled harder. He went to the blacksmith shop and returned with a small pair of tongs. He reached down with the tongs, grasped the piece of babbitt, and pulled. It still wouldn't budge.

The portable gas electric crane was working nearby stacking some driver tires. Evans caught the crane operator's eye and motioned for him to come.

"Pick up one end of that channel iron with the crane hook," Evans told the crane operator.

Then the foreman saw why he could not pick up the piece of babbitt. It was part of a chunk that had run through the crack and down under the channel iron. Evans got a couple of laborers to help and with the crane lifted up all of the channel iron floor. There wasn't a gold mine, but there was over a ton of babbitt that had over a period of years melted and run through the cracks in the channel iron floor.

Birch Single-Car Testing Device

The present type of single-car testing device is of rotary-valve construction and hence subject to scoring of the valve or its seat. This at times undesirably connects one on to another and gives a false indication, and the defect in the testing device is not discovered until it is itself tested in a specially-designed test rack. Since test racks are usually located only at main points where facilities are available for making repairs, the testing devices must be shipped to such points and returned again, exposing them to damage in handling. Duplicate devices are also required to replace those en route to and from such repair points.

To overcome the difficulties mentioned, T. H. Birch, air brake foreman, Chicago, Milwaukee, St. Paul & Pacific, Milwaukee, Wis., has designed a single-car testing device which has been thoroughly tested and recently authorized for use by the Association of American Railroads. Patent application has been filed. The functions of this new type tester are identical with the present A. A. R. standard device but, instead of having a rotary valve, the rate of reduction or increase in brake-pipe pressure is governed by separate and individual valves. Nos. 1, 2, 4, 5, 6, and 7, respectively. For instance, with No. 1 valve open and the other valves closed, this position is identical with Position 1 of the Westinghouse device. With No. 2 valve open and all other valves closed this setup is identical with Position 2 of the Westinghouse device; and with all valves closed it is identical with Position 3. By opening No. 4 valve with all other valves closed, it is the same as Position 4; opening No. 5 valve with all other valves closed is the same as Position 5; and with No. 6 valve open and all others closed it is identical with Position 6. In opening No. 7 valve with all others closed, it is the same as opening the ⅜-in. test-device cock. Positions 1, 2, 3, 4, 5, and 6, with the ⅜-in. test-device cock refers to the positions obtained in the present A. A. R. single-car testing device, shown on pages 24 to 27 of the Westinghouse Instruction Pamphlet No. 5039-4.

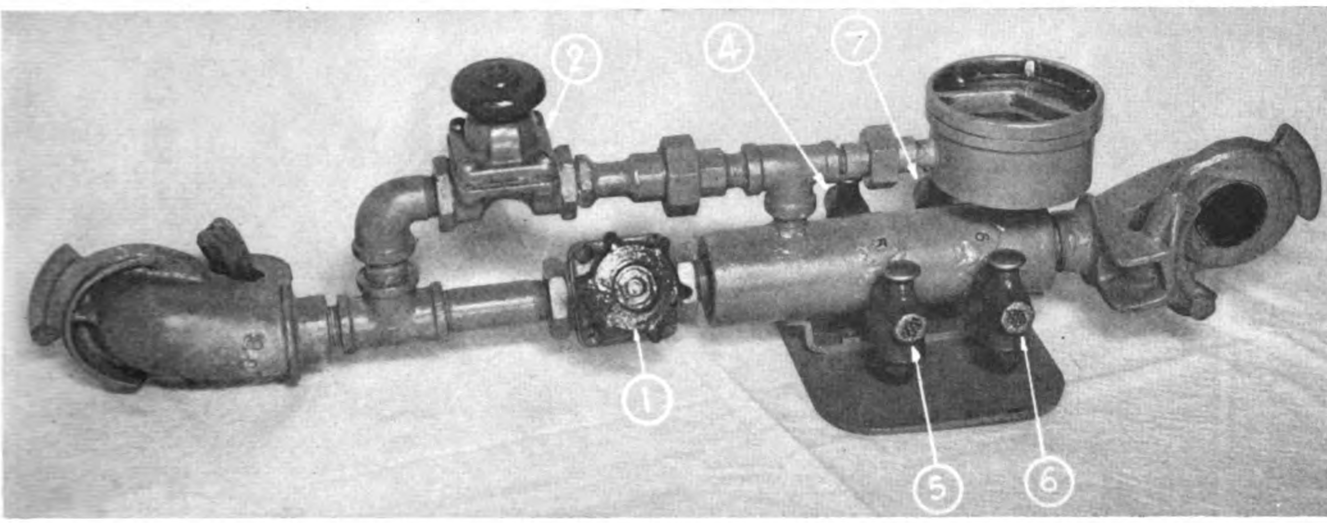
In the new device, the rates of brake-pipe reduction are controlled by a choke fitting with the proper-size orifice inserted in the nipples, to which the self-closing valves are attached. The rate of increase in brake pipe pressure is controlled by an orifice set in the union (2).

The advantages of the new-type single-car testing device are said to include the following:

(1) Leakage can be immediately detected at the local point and remedied at that local point without shipping to any main point for test-rack test. The device is charged, and after disconnecting it from the air supply, the gage is noted for any drop in air pressure, which indicates leakage.

(2) If leakage exists, the device can be immersed in water while it is still charged with air pressure and the point of leakage will be located by rising bubbles.

(3) Inasmuch as this leakage would usually be found in the rubber seats which are part of valves 4, 5, 6, and 7, on the diaphragm which is a part of valves 1 and 2, correction can be made immediately by renewal of either the rubber seat or the diaphragm. The construction of these valves is such that, in order to renew the rubber seat in valves 4, 5, 6, and 7, it is only necessary to remove the cap nut, change the rubber seat, and then replace the nut. In order to change the diaphragm in valves 1 and 2, remove the four machine screws, then remove the bonnet and thereby expose the diaphragm.



1—Full release
2—No. 74 drill orifice
4—No. 65 drill orifice
5—$^5/_{64}$-in. drill orifice
6—No. 26 drill orifice
7—¼-in. drill orifice

Birch single-car testing device now officially authorized for use in testing air brake equipment

* * *

No. 6 Gerlinger gasoline-operated lumber-handling truck and skids at the Missouri Pacific shops, Sedalia, Mo.

Air Brake Questions and Answers

AB-8, Empty and Load Equipment (Continued)

35—*Q.—How many positions has the transfer piston?* A.—Two. Closed, in which it remains on the upper seal. Open, in which it seats on the lower seal (cover gasket).

36—*Q.—What does the piston do in the upper, or closed, position?* A.—It cuts off the load cylinder in empty position.

37—*Q.—What does it do in lower, or open, position?* A.—It connects the brake-cylinder pipe to the load cylinder in load position.

38—*Q.—Does the transfer valve open immediately?* A.—Not until 20 lb. empty cylinder pressure is built up.

39—*Q.—What brings about this delayed opening?* A.—Spring *46* is of such a value that 20 lb. empty cylinder pressure is required to overcome it.

40—*Q.—There is a plunger (3) positioned on the transfer piston. What is its function?* A.—It functions to control the position of empty cylinder check valve *47* through transfer piston movement.

41—*Q.—What is the duty of the empty cylinder check valve?* A.—With its spring it prevents back flow from the empty to the load cylinder.

42—*Q.—What is the duty of the release check valve?* A.—With its spring it prevents the release from the empty cylinder until a predetermined initial release takes place from the load cylinder and controls the desired difference in pressure in the empty and load cylinders during release.

The Strut Cylinder

43—*Q.—What is the purpose of the strut cylinder?* A.—Its purpose is to measure the car truck spring deflection and automatically condition the brake for empty operation when the car is less than half loaded, and for load operation when the car is over half loaded.

44—*Q.—Where is it installed?* A.—On the end of the truck bolster (Fig. 8).

45—*Q.—Referring to Fig. 9, what parts are contained in the body portion and where is it fastened?* A.—It is bolted to a bracket having two pipe connections and contains a piston equipped with a ring and piston rod. The rod is connected through the piston spring to a foot outside the body.

46—*Q.—What is the normal position of the piston?* A.—In release position it is up.

47—*Q.—During the recharge period, what movement occurs?* A.—Air from the cut-off portion causes the piston to move down until the foot comes in contact with a piston stop on the truck.

48—*Q.—What determines the amount of travel of the piston in its cylinders?* A.—This depends on the truck-spring deflection, inasmuch as the strut cylinder is mounted on the truck bolster, and the piston stop on the truck member below the truck spring.

49—*Q.—What is the relation of piston stroke to car load?* A.—The piston stroke decreases as the car load increases, due to the fact that the piston is brought closer to the piston foot on account of the deflection of the truck spring.

50—*Q.—With a car less than half loaded the setting should be determined as empty. How is this accomplished?* A.—A port from the change-over portion and leading into the cylinder wall is exposed by the piston stroke under the above condition which admits air from the change-over valve.

51—*Q.—With a car more than half loaded, the setting should be determined as load. How is this accomplished?* A.—The port is not uncovered due to the fact that the piston stroke is insufficient. The face of the change-over valve piston is now open to the atmosphere through the strut cylinder exhaust.

52—*Q.—At what brake-pipe pressure is the strut operated to determine the setting?* A.—Only at such time as the brake-pipe pressure is under 30 lb.

53—*Q.—In view of this feature, how is the longevity of the strut cylinder parts affected?* A.—There is no wear from truck vibration as the piston and foot valve is always retracted.

54—*Q.—What indicates that the change-over valve is in empty position?* When the empty brake cylinder piston moves out alone.

55—*Q.—If the brake pipe has been depleted, recharged and an application made, what piston movement results?* A.—Both cylinder push rods should move out; an indication that the equipment is in load position.

56—*Q.—During the preliminary charging of the change-over valve, how does the brake-pipe air get to the slide valve chamber K of the cut-off valve portion?* [Note: These references are to Plate 1—Operation—EDITOR.] A.—Through the strainer and choke in the ABEL-1 pipe bracket and pipe *11* to the change-over valve bracket and choke *103* to the slide valve chamber.

57—*Q.—What holds it in this position?* A.—Spring *76* above cut-off diaphragm *72*.

58—*Q.—What communications are open in this position?* A.—Through passage *9* to the strut cylinder volume and to chamber *D* on the face of latch piston *20*, and to the upper side of strut cylinder piston *3* via pipe *9*.

59—*Q.—At what point does the piston shoe contact the piston stop?* A.—When sufficient air pressure is obtained to force the strut cylinder piston down, which is approximately 13 lb.

60—*Q.—As it is necessary to obtain air in chamber A on the face of the large change-over piston on an empty car, how is this accomplished?* A.—Due to the strut cylinder piston movement, the lower port in the side of the cylinder is uncovered. This permits a flow of air from the strut cylinder through pipe *4* in the change-over valve to the chamber on the face of the large change-over piston.

61—*Q.—What moves the latch 27 away from contact with the change-over piston?* A.—This is brought about as the latch piston moves in and by means of angle lever *26*.

62—*Q.—When does this happen?* A.—When air in chamber *D* on the face of the latch piston builds up to about 20 lb.

63—*Q.—With the same air pressure now acting on the face of the two change-over pistons, what happens?* A.—The piston moves to its empty position on account of the difference in the piston area.

64—*Q.—During the release and full charge (empty position-Plate 2) what causes the cut-off piston and slide valve to move to cut-off position?* A.—When the air pressure beneath the cut-off-valve diaphragm is more than 20 lb., the diaphragm is deflected by its spring resulting in movement of cut-off piston *66* and slide valve *67* to cut-off position. Passage *9* is then connected to the exhaust port *At* in the change-over piston via the

slide valve cavity. Air is thus vented from the strut cylinder, the face of the small change-over piston and the face of the latch piston.

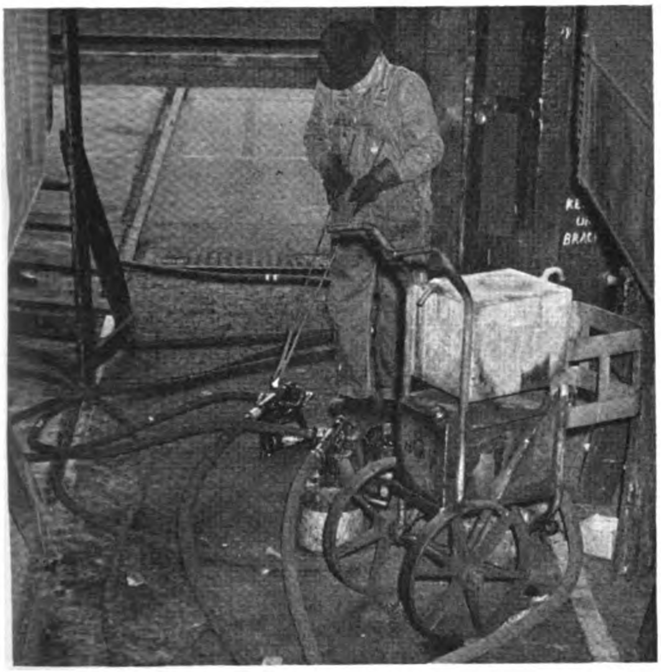
Pneumatic Conveyor System Speeds Riveting Jobs*

The accompanying photographs show a type of pneumatic rivet conveyor system developed by Clarence Reynolds, general foreman, boiler department, South Louisville shops of the Louisville & Nashville. Through the use of this device hot rivets propelled by compressed air can be shot through heat-resisting hose at a speed of 75 ft. a second for distances as great as 400 ft. horizontally and 75 ft. vertically. Any size rivet can be conveyed, provided the hose and conveyor gun are of the proper size; the equipment shown is for ⅝-in. rivets.

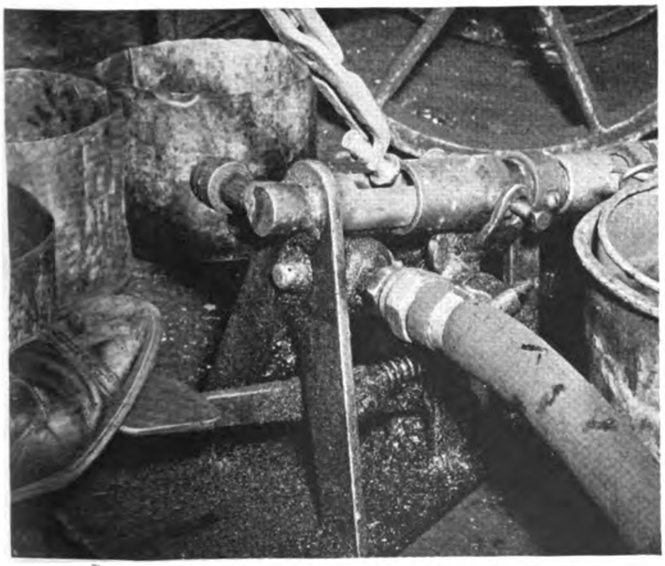
After being heated, the rivet is placed head-first in a slotted metal tube coupled to the hose and positioned in a device that is connected to the compressed-air supply. The pressure of the operator's foot on a pedal slides a jacket over the rivet, effectively chambering it and simultaneously releases compressed air into the chamber. Generally a pressure of about 85 lb. per sq. in. is used. Under the impetus of the compressed air, the rivet passes through the hose and drops into a stopping cup where it can be removed and applied.

An advantage of this type of conveyor system is that rivets can be conveyed around corners and to places where it would be difficult to toss them without a relay. One rivet heater can supply as many as three widely separated riveting jobs at the same time.

* Reproduced, in part, from the L. & N. Magazine.



General view of the conveyor system showing the manner in which a hot rivet is dropped into the receptacle



The foot pedal arrangement, showing how the chamber is closed after the rivet is inserted

Decisions of Arbitration Cases

(The Arbitration Committee of the A. A. R. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Intermediate Line Card Final As to Axle Dimension

The Western Maryland changed wheels on American Refrigerator Transit car No. 481 on account of an owner's defect, the wheel statement reporting second-hand axles of proper dimensions having been put in and removed. Subsequently, the Baltimore & Ohio removed the wheels and the axle previously applied by the W. M. on account of defects in both wheels and scrapped the axle because of a small wheel seat, the B. & O. applying new wheels and a second-hand axle in replacement thereof. The car owner forwarded both sets of repair cards to the W. M. in joint evidence under Rule 90 requesting adjustments to cover charges connected with wrong repairs. The W. M. refused to recognize the B. & O. repair cards as holding the final authority of joint evidence and refused adjustment. The A. R. T. contended that the scrapped axle was necessarily removed by the B. & O. and replaced by a good axle in order to comply with the requirements of Section (a), Rule 86 and to avoid responsibility in perpetuating wrong repairs. The A. R. T. requested adjustment equivalent to that which would be billed against the W. M. if their defect card had been issued in accordance with Rule 87 including the difference in material value between second-hand and scrap axle; also labor and incidentals associated with repairing owner's defects and the correction of wrong repairs according to the principal established in the third condition described in Interpretation (12) to Rule 107. In its statement of facts, the W. M. contended that in view of the original record of repair which established the fact that the axle applied was of the proper size, the B. & O. repair card could not be considered as joint evidence under Rule 90. The repairs were not made by the B. & O. until eight months after repairs were made by the W. M. and, for that reason, the W. M. would not consider the B. & O. as an intermediate

line under provisions of Rule 90. The W. M. requested clarification in connection with the proper application of Rule 90 in the use of a subsequent repair card as joint evidence: (1) Does the rule establish an indefinite time limit? (2) Extent of responsibility of road originally making repairs in connection with the case under discussion; (3) Can a road be considered an intermediate line regardless of the number of times the car is interchanged prior to repairs or is it the intent of the rule that the correction of improper repairs should be made on the first interchange movement subsequent to the date the original repairs were made?

In a decision rendered January 31, 1941, the Arbitration Committee stated that investigation of B. & O. wheel shop records developed that the wheel seat measurement was taken before turning and without any allowance for metal that would be removed due to turning. The car not having been home between the date the axle was applied by the W. M. and the date it was removed by the B. & O. Rule 90 governs and the contention of the A. R. T. is sustained.—*Case No. 1782 American Refrigerator Transit versus Western Maryland.*

Substitution of Truck Bolster Constitutes Temporary Repairs

On September 23, 1939, the Illinois Central applied a second-hand cast-steel truck bolster to car SDRX No. 1884 to replace a broken pressed-steel bolster and rendered a bill against the Sinclair Refining Company in accordance with Rule 101, item 114 and Rule 104, Section L of the 1939 code. An I. C. defect card was not attached to the car for the correction of wrong repairs. The owners executed a joint evidence card and forwarded it to the I. C. which company furnished defect card for labor only to the Sinclair Refining Company. That company took exception to the fact that the charge was confined to labor only, contending that certain undesirable features of the cast-steel bolster rendered it unsuitable as a permanent repair. The Sinclair Refining Company contended that Decision No. 1745 covered a similar case in that a bolster unsuitable for permanent use under a car can be considered only as temporary repairs. The I. C., in its statement, justified the issuance of a defect card for labor only on the ground that it complied with their interpretation of Rule 88 and contended further that certain differences in dimensions between the standard and the cast-steel bolster could have no effect on the service of the bolster as there are numerous cars in service, the bolsters of which differ in dimension in a similar manner.

In a decision rendered November 14, 1940, the Arbitration Committee stated: "The joint evidence indicates that the bolster applied was unsuitable for permanent use under the car in question and can only be considered as temporary repairs. The principal of decision No. 1745 applies. The contention of the Sinclair Refining Company is sustained."—*Case No. 1781, Sinclair Refining Company versus Illinois Central.*

Low-Center Flat Cars Built At Sacramento Shops

From the point of view of the car foreman and the car inspector, one of the most interesting jobs recently done at the Southern Pacific shops, Sacramento, Cal., was the

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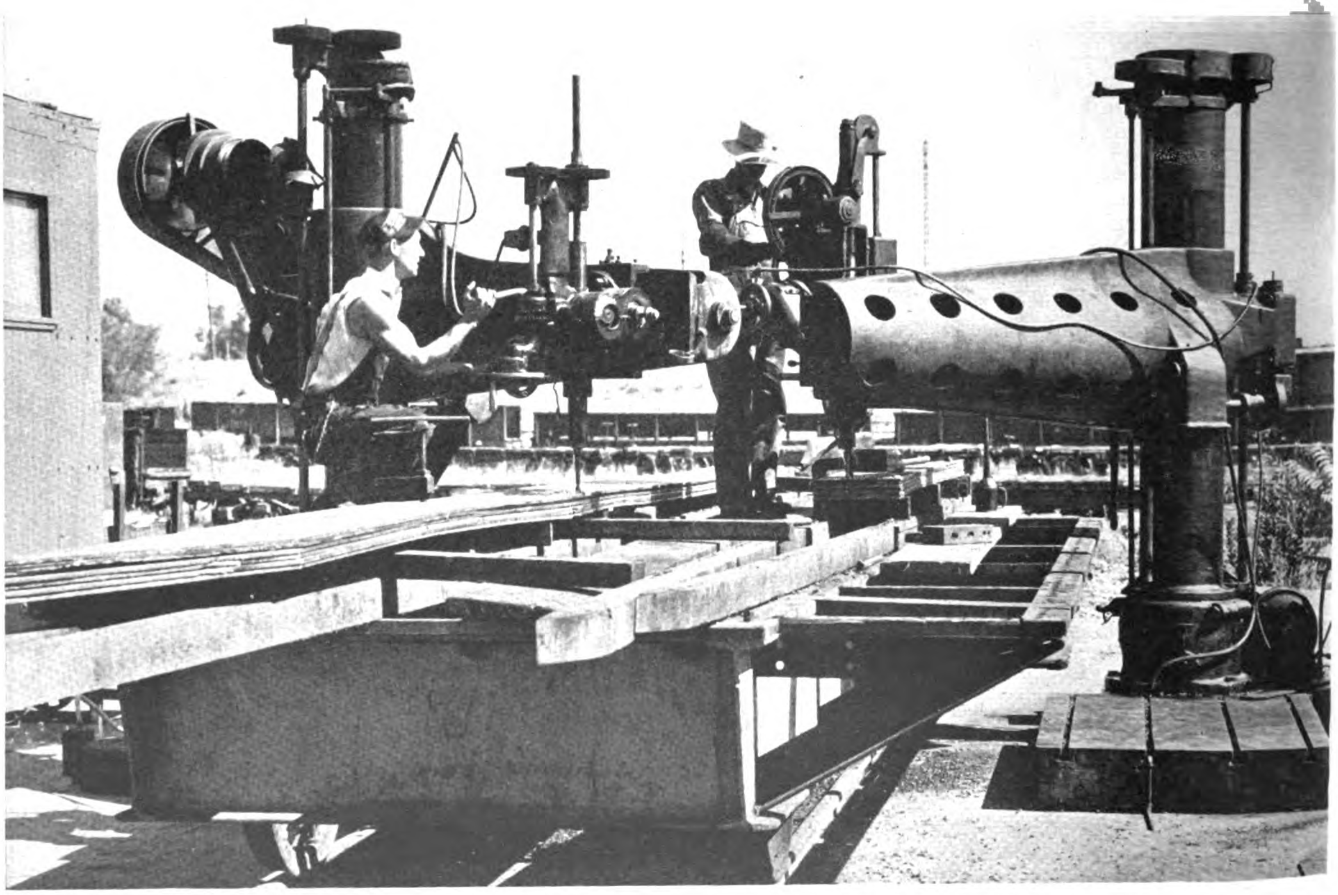


Stack-drilling six web plates at a time with each of two radial drills at Sacramento general shops

building of 10 reinforced steel depressed-center flat cars required to haul oversize loads, such as the 57-ton marine boiler, illustrated. This car is 52 ft. long, weighs 66,000 lb., and has a nominal carrying capacity of 70 tons. The depressed center of the car varies from 2 ft. 2 in. to 2 ft. 6 in., above the rails, dependent upon the load. Owing to the heavy construction required to carry large concentrated loads at the center of this car, also the relatively small number of units built, the cost per car is approximately $5,000.

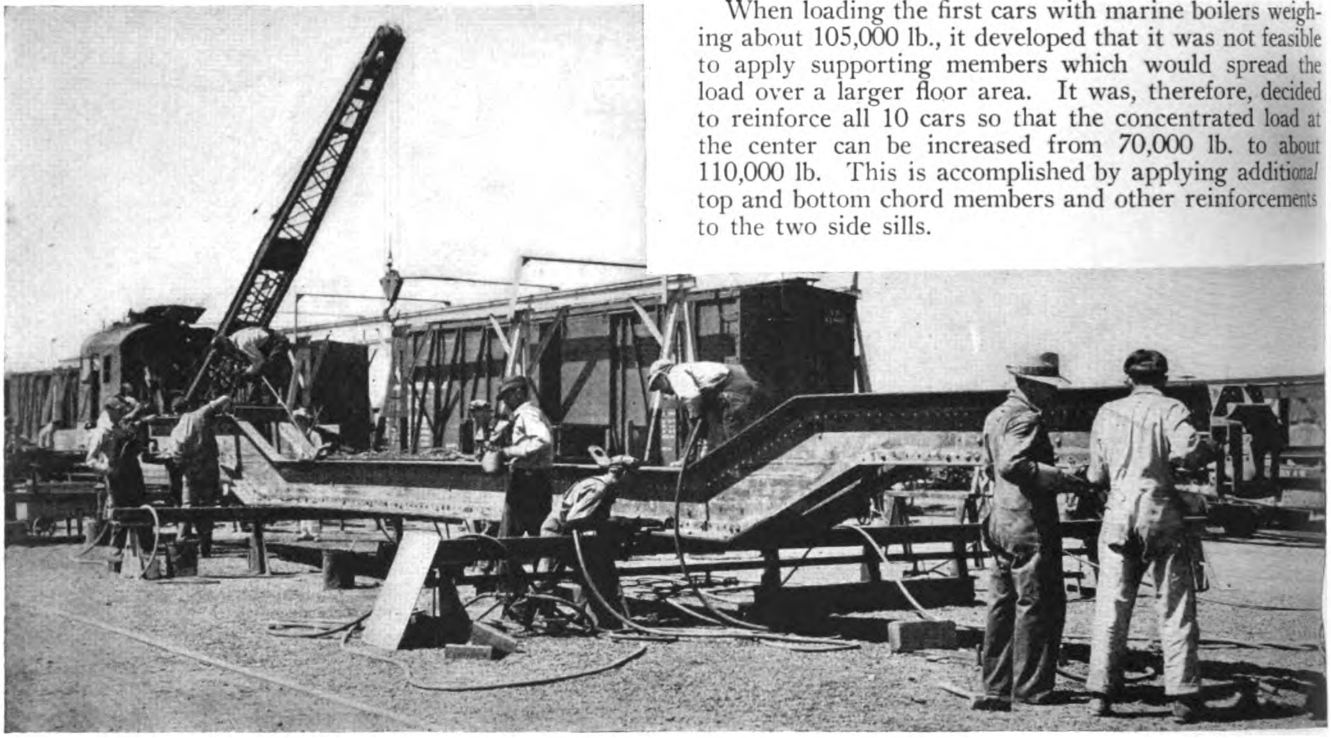
According to an article published in the Southern Pacific Bulletin for November, the main items of the car body are the four longitudinal members (two center sills and two side sills) each of which had to be built up of plates and angles. As no steel plates of about 36 in. width and 52 in. length were available, each web plate of these sills was made of the following five pieces of plates, cut to the proper shape and then welded together: Two end pieces, about 16 in. wide and sloped at one end, one center piece, about 16 in. wide and sloped at both ends in the opposite direction, and two small intermediate plates, from 3½ in. to 5 in. wide, with the ends sloped parallel to each other. The resulting plate is 35½ in. wide overall, with portions about 19½ in. wide cut out at the ends and center.

A row of holes is then drilled along the top and bottom edges of the web plates for application of the top and bottom chord angles. About six plates are placed together and drilled at the same time. The holes in most of the remaining longitudinal members are punched instead of drilled, after a jig has been made which insures the proper spacing. When riveting the chord angles to the top and bottom of the web plates, these angles are straight and are first riveted to the depressed or center portions of the web. They are then heated and bent parallel to the edges of the sloped portions of the web and riveted thereto. The ends are then bent again and riveted to the horizontal ends of the web plates. The two center sills are provided with the necessary spacers, and a ¾-in. by 28-in. plate is riveted to the bottom to form a single column. A narrower reinforcing plate is applied to the bottom of the side sills.

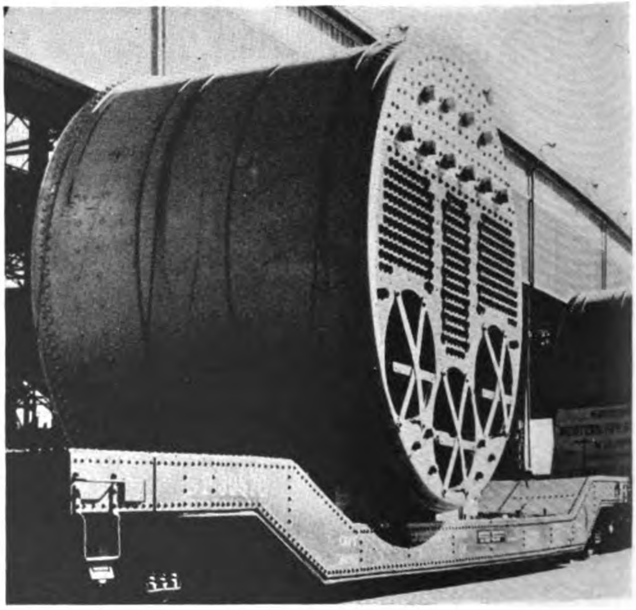
The next step is to apply the transverse members (end sills, bolsters, crossbearers and crossties) to the center sills and to rivet the side sills to the ends of the transverse members. The last step in constructing the body is to rivet the floor plates to the various framing members and to weld the joints between the plates to obtain a continuous surface from end to end of the car. These plates have holes for the bolts securing the loads and other holes large enough for a man's hand to permit the insertion of these bolts.

It is the usual practice to design such cars for a concentrated load of 70,000 lb., or half the nominal capacity, loaded within a space of 3 ft. at the center of the car, or for larger loads up to 70 tons, properly distributed.

When loading the first cars with marine boilers weighing about 105,000 lb., it developed that it was not feasible to apply supporting members which would spread the load over a larger floor area. It was, therefore, decided to reinforce all 10 cars so that the concentrated load at the center can be increased from 70,000 lb. to about 110,000 lb. This is accomplished by applying additional top and bottom chord members and other reinforcements to the two side sills.



Riveting chord angles to web plates in the process of building the heavy main sills of the car



Southern Pacific low-center flat car carrying 57-ton marine boiler built in conjunction with the national defense program

(*Turn to next left-hand page*)

High Spots in

Railway Affairs . . .

Profit in Suggestions From the Employees

The Illinois Central has maintained an employees' suggestion plan for several years. About two and a half years ago it made some changes which have considerably speeded up its productiveness. In a period of 27 months under the new arrangement, more than 38,000 suggestions were made, about 10 per cent of which were adopted. Some of the ideas are of a minor nature and such that the benefits cannot be measured in dollars and cents. Nominal sums are paid for such ideas, even though the benefits are intangible. Where suggestions results in savings and the profits can be measured, based on labor, materials, supplies, etc., awards are made approximating 10 per cent of the net savings for the first year. The awards, which totaled $37,000 for the period mentioned, ranged from a minimum of $5, to a maximum of $1,863. One of the mechanical department employees has won 56 times since the beginning of the plan. Others, both male and female, are frequent repeaters. The employee fills out a suggestion blank when he makes his recommendations. The system is administered by a small staff, under the jurisdiction of the assistant to the president, all of the time of the staff being concentrated on this particular activity.

Engineering Convention Exhibits

Unlike the mechanical department associations, which are restricting their annual meetings to those of their general or executive committees, or are eliminating the meetings entirely, the railroad engineering associations continue to go merrily on with their conventions and also with their exhibits. The National Railway Appliances Association, which makes its exhibit in Chicago at the time of the convention of the American Railway Engineering Association, has just announced that next March it will utilize the 122nd Field Artillery Armory. This is closer and more convenient to the convention headquarters, and it will be possible to house all of the exhibitors within one large area. The promoters of the exhibit believe that there will be a considerable increase in the number of companies that will exhibit next March.

Steel Distribution Badly Administered

Washington today controls the allocations of steel. Railroads, a vital factor in national defense, are deeply concerned because of the lack of steel for building freight cars and locomotives. John H. Van Deventer, capable editor of Iron Age, and certainly an authority on steel production, pointed out to the Executives Club at Chicago a short time ago that, at an outside calculation, not more than 40 per cent of the present steel producing capacity is required for defense purposes. "On the basis of our present ingot-producing rate, 80 million tons," he said, "the remaining 60 per cent which should be available to non-defense industries amounts to 48 million tons, or enough to permit these non-defense industries to do business almost on their 1939 basis." Again he said, "So long as we have at least 60 per cent of our present steel-making capacity theoretically available for non-defense business, the chief reason for anyone not getting at least some steel is mal-distribution. We have priorities, and having priorities in the way that we have had them, we have got ourselves into a mess, because priorities are being used as a substitute for planning."

Trans-Saharan Railroad

The renewed hostilities in North Africa have done much to focus attention on the railroad now being built across the Sahara Desert by the Vichy government. The Railway Age in discussing why a railroad was decided upon, rather than highway or water transportation, refers to studies made by French experts in 1929 and 1930. A train hauling up to 3,000 net tons on a direct route, at 40 m.p.h., would require two crews of three men each to make the trip. A coastwise cargo vessel handling the same tonnage, over a round-about route and traveling at a speed of 15 m.p.h., would require a minimum crew of 15. The same load carried by highway trucks would require 600 five-ton trucks and a minimum of 1,200 drivers for the long journey. Estimated costs of transportation over the entire route would amount to from 300 to 1,000 francs per metric ton by railroad, 7,000 to 10,000 francs by trucks over a highway on the assumption that it would be paid for by the users as in the case of the railroad, and 12,000 francs by air.

The Railroads' Future

In addressing the National Industrial Traffic League annual luncheon at Chicago, President Ernest E. Norris, of the Southern Railway, spoke frankly of the problems which confront the railroads. He emphasized the fact that when "this insane world war" is over "the railroads will have to face new and desperate competition for whatever traffic there will be." In concluding his address he said that "the railroads are going to lick the problems of tomorrow: the problems of depression, of competition, of dwindling revenues and inflexible expenses, of inequalities in the treatment of different forms of transportation." They will win out, he said, "partly because they have what it takes to do the job, the inherent strength, the resourcefulness, the courage, the will, the talent. But it will be the co-operation of the nation's shippers and the support of the American people that will really make this prediction come true."

Export Traffic in October

The railroads, in conjunction with the government and with splendid cooperation on the part of the shippers, are getting a high standard of productiveness from their freight cars. No longer, as was true in the first World War, are the freight cars being used for storage purposes. In October of this year 63,413 cars of export freight, other than grain or coal, were unloaded at Atlantic, Gulf and Pacific ports; this compared with 47,559 cars unloaded during October a year ago. There was also a very large increase in the amount of grain handled for export, 3,232 cars being unloaded in October of this year, as compared with 685 in the same month last year. The A.A.R. reported that, "No congestion or delay to traffic exists at any of the Atlantic, Gulf or Pacific ports, due to the co-operation of the steamship lines, port authorities, exporters and shippers."

Passenger Traffic Progress

The railroads, because of competition from other types of carriers, have suffered a heavy decline in passenger traffic during the past two decades. The introduction of streamline trains and the modernization of passenger equipment, with the speeding up of the service, turned the tide, so that the passenger traffic during the first two-thirds of 1941 was larger than the first two-thirds of any year since 1929, and in fact, was only 10 per cent smaller than in 1929. The Railway Age, in its annual Passenger Progress Number, not only stresses these facts, but points out that it was larger in the first two-thirds of 1941 than in any of the entire years 1932 to 1935, inclusive. There is no question but what the improvements in the passenger service have had a profound effect in cultivating a better attitude toward the railroads on the part of the public. There is evidence, also, that this has been reflected in an increase in freight traffic on the part of some of the shippers. The results have been inspiring to railroad management and have undoubtedly contributed to increased activities on a number of roads in systematic research of traffic problems.

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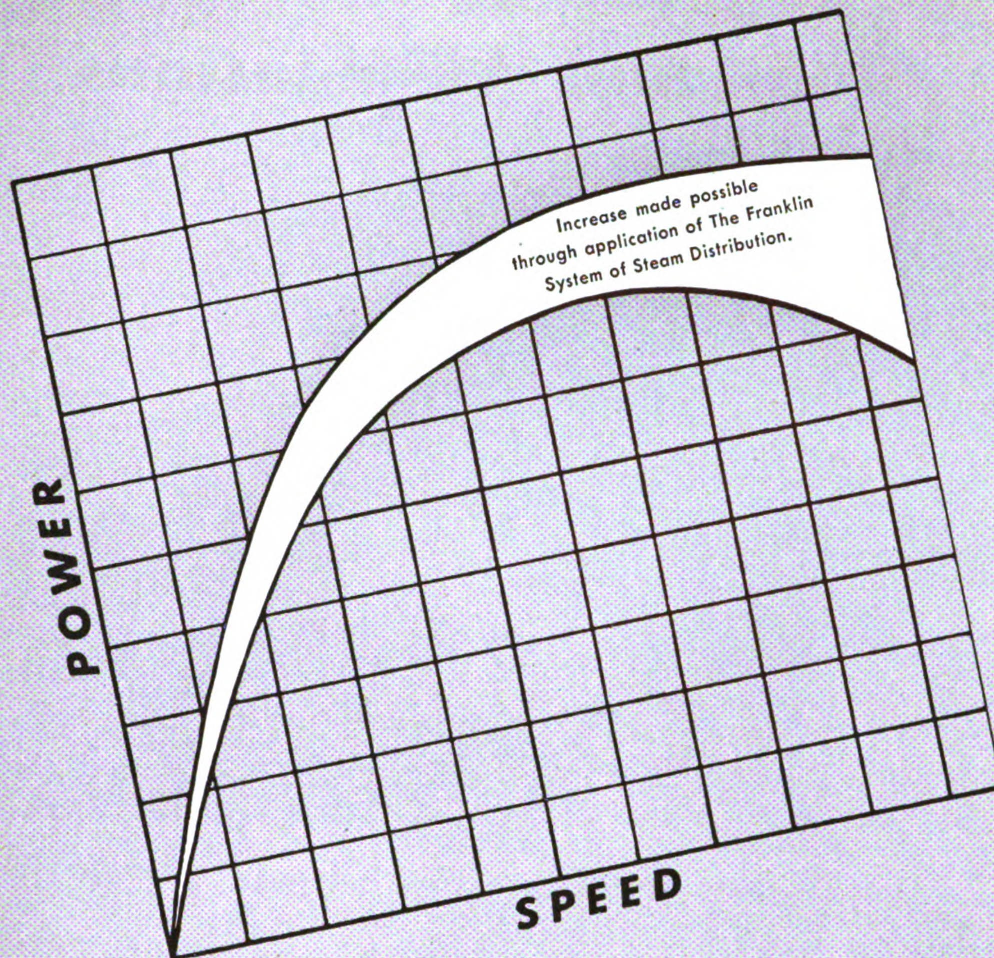

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Among the Clubs and Associations

NEW ENGLAND RAILROAD CLUB.—Meeting December 9, Hotel Touraine, Boston, Mass. Speaker: Paul C. Dunn, Boston & Maine. Subject: Selection and Training of Railroad Supervisors.

CAR DEPARTMENT ASSOCIATION OF ST. LOUIS.—Meeting December 16 at 8 p. m. at the Hotel DeSoto, St. Louis, Mo. Election of officers and Christmas party. Awarding of prizes for best short papers presented during year.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.—Meeting January 20 at the Hotel Ansley, Atlanta, Ga. Speaker: Arthur Williams, assistant chief engineer, in charge of Research Division, The Superheater Company. Subject: Superheater Unit Research and Development.

NORTHWEST CAR MEN'S ASSOCIATION.—Meeting held December 1. Speaker: F. G. Moody, superintendent car department, Northern Pacific. Subject: Handling and Maintenance of Equipment in Connection with National Defense.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Meeting December 8 at 8 p. m. at the La Salle Hotel, Chicago. Speaker: V. R. Hawthorne, executive vice-chairman, Association of American Railroads. Subject: Keep the Wheels Rolling.

WESTERN RAILWAY CLUB.—Meeting held November 17. Speaker: Dr. Charles Copeland Smith, National Association of Manufacturers. Subject: The American Way.

EASTERN CAR FOREMAN'S ASSOCIATION.—Meeting December 11, Hotel Commodore, New York, at 1:30 p. m. Annual meeting for election of officers and directors.

Mid-west Air Brake Club To Hold May Meeting

During the first week of May, 1942, the Midwest Air Brake Club will hold a two-day meeting at Parsons, Kan. The program being arranged for this meeting is as follows:

The Four-Position Pressure Retaining Valve and Its Effect Upon Freight-Train Handling; also modification of present A. A. R. three-position retainers to four-position type, by W. E. Vergan, general air brake supervisor, M-K-T.

Visit to M-K-T shops at Parsons to view maintenance of AB brakes in detail and shop work in general.

Review of the development of the AB freight-car brake by Westinghouse Air Brake Company representatives.

Demonstration of the H-6-V brake valve, by W. E. Vergan.

Locomotive air equipment repairs and maintenance at M-K-T shops, Parsons.

Review of the development of the ET locomotive equipment; also a paper on A Method of Removing Oil and Water from Yard and Shop Compressed Air Plants, by New York Air Brake Company representatives.

DIRECTORY

The following list gives names of secretaries, dates of next regular meetings, and places of meetings of mechanical associations and railroad clubs:

ALLIED RAILWAY SUPPLY ASSOCIATION.—J. F. Gettrust, P. O. Box 5522, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS—C. E. Davis, 29 West Thirty-ninth street, New York. Annual meeting Hotel Astor, New York, December 1-5.

RAILROAD DIVISION.—C. L. Combes, *Railway Mechanical Engineer*, 30 Church street, New York City. Railroad Division sessions at annual meeting of society, Hotel Astor, New York, December 4.

MACHINE SHOP PRACTICE DIVISION.—Warner Seely, Warner & Swasey Co., 5701 Carnegie avenue, Cleveland, Ohio.

MATERIALS HANDLING DIVISION.—F. J. Shepard, Jr., Lewis-Shepard Co., Watertown Station, Boston, Mass.

OIL AND GAS POWER DIVISION.—L. N. Rawley, Jr., Power, 330 West Forty-second street, New York.

FUELS DIVISION.—D. C. Weeks, Consolidated Edison Co., 4 Irving Place, New York.

ANTHRACITE VALLEY CAR FOREMEN'S ASSN.—Frank Kramer, 412 Hill street, Duryea, Pa. Meets third Monday of each month at Wilkes-Barre, Pa.

ASSOCIATION OF AMERICAN RAILROADS.—Charles H. Buford, vice-president Operations and Maintenance Department, Transportation Building, Washington, D. C.

OPERATING SECTION.—J. C. Caviston, 30 Vesey street, New York.

MECHANICAL DIVISION.—A. C. Browning, 59 East Van Buren street, Chicago.

PURCHASES AND STORES DIVISION.—W. J. Farrell, 30 Vesey street, New York.

MOTOR TRANSPORT DIVISION.—George M. Campbell, Transportation Building, Washington, D. C.

CANADIAN RAILWAY CLUB.—C. R. Crook, 4415 Marcill avenue, N. D. G., Montreal, Que. Regular meetings, second Monday of each month, except June, July and August, at Windsor Hotel, Montreal, Que.

CAR DEPARTMENT ASSOCIATION OF ST. LOUIS.—J. J. Sheehan, 1101 Missouri Pacific Bldg., St. Louis, Mo. Regular monthly meetings third Tuesday of each month, except June, July and August, DeSoto Hotel, St. Louis.

CAR DEPARTMENT OFFICERS' ASSOCIATION.—Frank Kartheiser, chief clerk, Mechanical Dept., C. B. & Q., Chicago.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—G. K. Oliver, 8238 S. Campbell avenue, Chicago. Regular meetings, second Monday in each month, except June, July and August, La Salle Hotel, Chicago.

CAR FOREMEN'S ASSOCIATION OF OMAHA, COUNCIL BLUFFS AND SOUTH OMAHA INTERCHANGE.—H. E. Moran, Chicago Great Western, Council Bluffs, Ia. Regular meetings, second Thursday of each month.

CENTRAL RAILWAY CLUB OF BUFFALO.—Mrs. M. D. Reed, Room 1840-2, Hotel Statler, Buffalo, N. Y. Regular meetings, second Thursday of each month, except June, July and August, at Hotel Statler, Buffalo.

EASTERN CAR FOREMAN'S ASSOCIATION.—W. P. Dizard, 30 Church street, New York. Regular meetings, second Friday of January, February (annual dinner), March, April, May, October, and November at Engineering Societies Bldg., 29 West Thirty-ninth street, New York.

INDIANAPOLIS CAR INSPECTION ASSOCIATION.—R. A. Singleton, 822 Big Four Building, Indianapolis, Ind. Regular meetings, first Monday of each month, except July, August and September, in Indianapolis Union Station, Indianapolis, at 7 p. m.

LOCOMOTIVE MAINTENANCE OFFICERS' ASSOCIATION.—Secretary-treasurer C. M. Lipscomb, Missouri Pacific, North Little Rock, Ark.

MASTER BOILER MAKERS' ASSOCIATION.—A. F. Stiglmeier, secretary, 29 Parkwood street, Albany, N. Y.

MID-WEST AIR BRAKE CLUB.—C. F. Davidson, secretary-treasurer, general inspector car department, St. L.-S. F., Springfield, Mo.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic avenue, Boston, Mass. Regular meetings, second Tuesday in each month, except June, July, August and September.

NEW YORK RAILROAD CLUB.—D. W. Pye, Room 527, 30 Church street, New York. Meetings, third Thursday in each month, except June, July, August, September and December at 29 West Thirty-ninth street, New York.

NORTHWEST CAR MEN'S ASSOCIATION.—E. N. Myers, chief interchange inspector, Minnesota Transfer Railway, St. Paul, Minn. Meetings first Monday each month, except June, July and August, at Midway Club rooms, 1931 University avenue, St. Paul.

NORTHWEST LOCOMOTIVE ASSOCIATION.—G. T. Gardell, 820 Northern Pacific Building, St. Paul, Minn. Meetings third Monday of each month, except June, July and August.

PACIFIC RAILWAY CLUB.—William S. Wollner, P. O. Box 3275, San Francisco, Cal. Monthly meetings alternately in northern and southern California.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 1647 Oliver Building, Pittsburgh, Pa. Regular meetings, fourth Thursday in month except June, July and August, Fort Pitt Hotel, Pittsburgh, Pa.

RAILWAY FUEL AND TRAVELING ENGINEERS' ASSOCIATION.—T. Duff Smith, Room 811, Utilities Building, 327 South La Salle street, Chicago.

RAILWAY SUPPLY MANUFACTURERS' ASSOCIATION.—J. D. Conway, 1941 Oliver Building, Pittsburgh, Pa.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.—A. T. Miller, P. O. Box 1205, Atlanta, Ga. Regular meetings, third Thursday in January, March, May, July and September. Annual meeting, third Thursday in November, Ansley Hotel, Atlanta, Ga.

TORONTO RAILWAY CLUB.—D. M. George, Box 8, Terminal A, Toronto, Ont. Meetings, fourth Monday of each month, except June, July, and August, at Royal York Hotel, Toronto.

WESTERN RAILWAY CLUB.—E. E. Thulin, executive secretary, Room 822, 310 South Michigan avenue, Chicago. Regular meetings, third Monday in each month, except June, July, August, September, and January.

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NEWS

A. A. R. Lumber Specifications

At a joint meeting of the Car Construction Committee of the Association of American Railroads and representatives of the lumber manufacturers, the following six suggestions were advanced, not with the thought of making them mandatory or permanent practice, but simply for the duration of the present emergency and to help solve the problem of securing lumber required for new equipment and repairs:

(1) It is suggested that the demand for edge grain material be confined to sections requiring wearing material, and not be insisted upon for lining and interior roofing.

(2) Require edge grain or heartwood only for the kind of wood and for the part of a car where either is absolutely necessary.

(3) Some railroads order select grades for use in repairs instead of common grades as recommended in A. A. R. Specification M-907-33. Under present conditions that procedure is undesirable. The supply situation in the lumber industry possibly would be better served if the common grades were substituted for the select grades in the flooring, lining and inside roofing of repaired cars.

(4) As an emergency proposition only, on new and existing cars where it is possible, lining of double sheathed cars to be ordered in two pieces in varying lengths of six feet and up, and applied to suit nailing post spacing. This does not apply to single sheathed cars. In view of the present emergency this arrangement is brought to the attention of the individual railroads for such action as they see fit.

(5) The "Use Classification" on pages 4 and 5 of Specification No. M-907-33 provides for several kinds of wood suitable for each detail part. Because so many railroads have limited their acceptable woods it is suggested that, in view of the present emergency, mechanical officers give consideration to other suitable woods shown in the specification.

(6) Wherever it is practicable inspection to be made by authorized lumber inspectors at point of origin rather than at destination, also for railroads not equipped to make such inspection, that arrangements be made for such inspection by authorized inspectors of other railroads located in the vicinity of the district from which lumber is being shipped. The lumber manufacturers believe this will avoid rejections at destination. This arrangement might be agreeable to some railroads under the present emergency and is a matter for a decision of individual railroads.

President Approves Lease-Lend Measure

President Roosevelt has signed H. R. 5788, the new lend-lease bill. As pointed out in the November *Railway Mechanical Engineer*, page 498, the measure includes an item of $25,000,000 for railway equipment and facilities to be used in the Middle East "theatres of war." Hearings on the bill before the Senate appropriations committee fail to show any reference to this item in the upper house committee discussions.

The bill also includes an item of $69,385 for the National Mediation Board. Some $55,000 of this amount will be used to reimburse the board's arbitration-and-emergency-boards account, from which will come funds to pay the expenses of the five-man emergency board now considering the wage-increase demands. The $14,385 item will enable the board to employ two additional mediators and provide additional funds for travel expenses.

Milwaukee 5,400-Hp. Diesel-Electric Freight Locomotives

A 5,400-hp. Diesel-electric locomotive that has been delivered to the Chicago, Milwaukee, St. Paul & Pacific by the Electro-Motive Corporation, and has been placed in high-speed freight service between Avery, Idaho and Othello, Wash., a distance of 227 miles. The locomotive replaces steam locomotives formerly used between the two electrified sections of the railway, and makes a round trip daily.

The four units of the new Diesel are 193 ft. in length and weigh 856,000 lb. Each unit is equipped with a 1,350 hp. 16-cylinder engine. The starting tractive force is 220,000 lb.

The locomotive is equipped with automatic boilers for heating trailing cars if it should be used in passenger service, electric dynamic holding brakes, automatic air brake control, and audible and visual signals that indicate low lubricating oil pressure, hot engine water, hot journals, and wheel slippage.

Ceiling Prices for Low-Alloy Steel Castings

Prices for carbon and low-alloy steel castings, including "railroad specialties," are prevented from going above approximately current levels, through the issuance of a price schedule on November 14 by Leon Henderson, administrator, Office of Price Administration. The schedule, effective November 15, provides that the maximum prices shall be those that prevailed on July 15, 1941.

Except for railroad specialties, these maximum prices will approximate those contained in the "Comprehensive Report of Price Lists of Miscellaneous Castings," issued by the Steel Founders' Society of America for the third quarter of 1941.

Any miscellaneous castings for which prices are not determined by the "Comprehensive Report" are to sell at not more than the July 15 prices, according to the schedule. Special provision is made for pricing of castings not previously produced by a manufacturer. Roughly, the castings involved fall into two groups: Railroad specialties and miscellaneous. The first includes side-frames, bolsters, yokes and couplers, used in the running gear of railroad freight and passenger cars. The mis-

The new 5,400-hp. Diesel-electric freight locomotive recently delivered to the C. M. St. P. & P. by the Electro-Motive Corporation

cellaneous castings field takes in all manner of products. Steel scrap is the principal raw material in the production of carbon and low-alloy castings.

The new schedule provides that applications may be made to OPA to complete outstanding contracts at higher than ceiling prices in certain special instances. Sworn affirmations of compliance are required to be filed monthly.

Equipment Purchasing and Modernization Programs

Chicago, St. Paul, Minneapolis & Omaha.—This company has asked the Interstate Commerce Commission for authority to assume liability for $1,210,000 of equipment trust certificates, maturing in 10 equal annual installments of $121,000 on December 1 in each of the years from 1942 to 1954, inclusive. The proceeds will be used as part of the purchase price of equipment costing a total of $1,621,000 and consisting of 500 40 ft. 6 in. box cars.

Pennsylvania.—As part of its contribution to the national defense, the Pennsylvania is engaging in a most important and far-reaching program for the enlargement and improvement of its freight car supply. The program calls for the construction, during 1941 and 1942, of 11,876 new freight cars, and the complete reconditioning, by Class I heavy repairs, of approximately 3,000 cars per month. This will add 9,600 cars to the available supply by the close of the present year, and over 23,000 by October 1, 1942, just prior to the annual traffic peak. By that date, also, the proportion of freight cars under or awaiting repairs is expected to be reduced to 3.4 per cent, a minimum practicable working level.

The program also includes the building of 25 locomotives and heavy repairs to existing engines at the rate of 200 per month.

In the 12-year period from January 1, 1930, to the end of the present year, installations of new equipment on the Pennsylvania will have totaled over 35,000 freight cars and 336 locomotives. In the same period, the railroad has spent an aggregate of $667,500,000 on betterments, improvements and additions to its general facilities for rendering service.

The 3,000 repaired cars which the Pennsylvania is turning out of its shops each month are, according to the railroad, in every respect the equivalent of new cars from a service and utility standpoint. Only those parts are preserved in the repair process which are capable of giving results, substantially equivalent to new and, in addition, all improved and modernized features are applied.

Union Pacific.—The enginehouse facilities of the Union Pacific at Ogden, Utah, are being extended and rearranged at a total cost of approximately $109,000 to accommodate the new large locomotives recently placed in service in this territory. A contract in connection with this work, amounting to approximately $58,000 has been awarded the James Leck Company, Minneapolis, Minn. The work includes the construction of three track drop pits and a table.

Pullman Trial Begins at Philadelphia

On November 3 the federal government inaugurated an anti-trust suit against the Pullman organization in the United States District Court at Philadelphia, Pa., before a special three-judge "expediting" court composed of John Biggs, Jr., H. F. Goodrich, and Albert Maris. The suit (Civil Action No. 994) was first filed on July 12, 1940, and refiled in amended form on July 22, 1941. It names as defendants Pullman, Inc., its wholly-owned subsidiaries, the Pullman Company (operator of sleeping car service), Pullman-Standard Car Manufacturing Corporation (car building unit) and Pullman Car & Manufacturing Corporation of Alabama (leases car manufacturing facilities to Pullman-Standard) and 31 directors and officers of these companies.

Allegations specified in the *amended*

(*Continued on second left-hand page*)

Orders and Inquiries for New Equipment Placed Since the Closing of the November Issue

Locomotives

Road	No. of Locos.	Types of Locos.	Builder
American Steel & Wire Co.	1	300-hp. Diesel-elec.	Whitcomb Loco. Co.
Arkansas Ordnance Plant	1	50-ton Diesel-elec.	General Electric Co.
Baltimore & Ohio	6	600-hp. Diesel-elec.	Electro-Motive Corp.
	4	1,000-hp. Diesel-elec.	
Belt Rwy. of Chicago	1	1,000-hp. Diesel-elec.	Baldwin Loco. Works
Chemical Warfare Arsenal	2	65-ton Diesel-elec.	General Electric Co.
Chesapeake & Ohio	10	2-6-6-6	Lima Loco. Works
Chicago & North Western	1	1,000-hp. Diesel-elec.	American Loco. Co.
	1	600-hp. Diesel-elec.	
Johns-Manville Service Co.	1	380-hp. Diesel-elec.	Whitcomb Loco. Co.
Litchfield & Madison	1	1,000-hp. Diesel-elec.	Baldwin Loco. Works
Lone Star Defense Corp.	2	65-ton Diesel-elec.	General Electric Co.
Macon, Dublin & Savannah	1	1,000-hp. Diesel-elec.	Baldwin Loco. Works
Mississippi Export	1	44-ton Diesel-elec.	General Electric Co.
New Orleans Public Belt	3	660-hp. Diesel-elec.	Baldwin Loco. Works
Pere Marquette	4	1,000-hp. Diesel-elec.	Electro-Motive Corp.
	1	600-hp. Diesel-elec.	
Richmond, Fredericksburg & Potomac	2[1]	660-hp. Diesel-elec.	American Loco. Co.
Southern Pacific	3	44-ton Diesel-elec.	General Electric Co.
Union Railroad	5	1,000-hp. Diesel-elec.	Electro-Motive Corp.
	2	1,000-hp. Diesel-elec.	American Loco. Co.
U. S. Navy Dept.	1	25-ton Diesel-elec.	Atlas Car & Mfg. Co.
	2	Diesel-elec.	General Electric Co.
	1	Diesel-elec.	Whitcomb Loco. Co.
U. S. War Dept.	20[2]	2-8-8-2	American Loco. Co.
Upper Merion & Plymouth	1	600-hp. Diesel-elec.	Baldwin Loco. Works
	1	80-ton Diesel-elec.	General Electric Co.
Weldon Springs Ordnance Plant	2	45-ton Diesel-elec.	General Electric Co.
Western Pacific[3]	8	600-hp. Diesel-elec.	American Loco. Co.

Locomotive Inquiries

Delaware & Hudson	10-15	4-8-4	....
Pennsylvania	1	4,000-hp. Diesel-elec.	....
U. S. Navy Dept.	1	Diesel-elec.	....
U. S. Navy Dept., Bureau of Supplies and Accounts	1	Diesel-elec.	....

Freight-Car Orders

Road	No. of Cars	Types of Cars	Builder
Bessemer & Lake Erie	425	90-ton hopper	Pull-Std. Car Mfg. Co.
	300	50-ton gondola	Greenville Steel Car Co.
	200	50-ton gondola	Pressed Steel Car Co.
Bethlehem Steel Co.	120[4]	50-ton gondola	Company shops
Central of New Jersey	50	70-ton cement hopper	American Car & Fdy. Co.
Chicago, Milwaukee, St. Paul & Pacific	5	70-ton gondola	Bethlehem Steel Co.
Lehigh Valley	1,000	50-ton coal	Bethlehem Steel Co.
Mathieson Alkali Works	6	50-ton box	American Car & Fdy. Co.
Pittsburgh & West Virginia	5	Caboose	Bethlehem Steel Co.
Wabash Car & Equipment Co.	25	70-ton covered hopper	American Car & Fdy. Co.

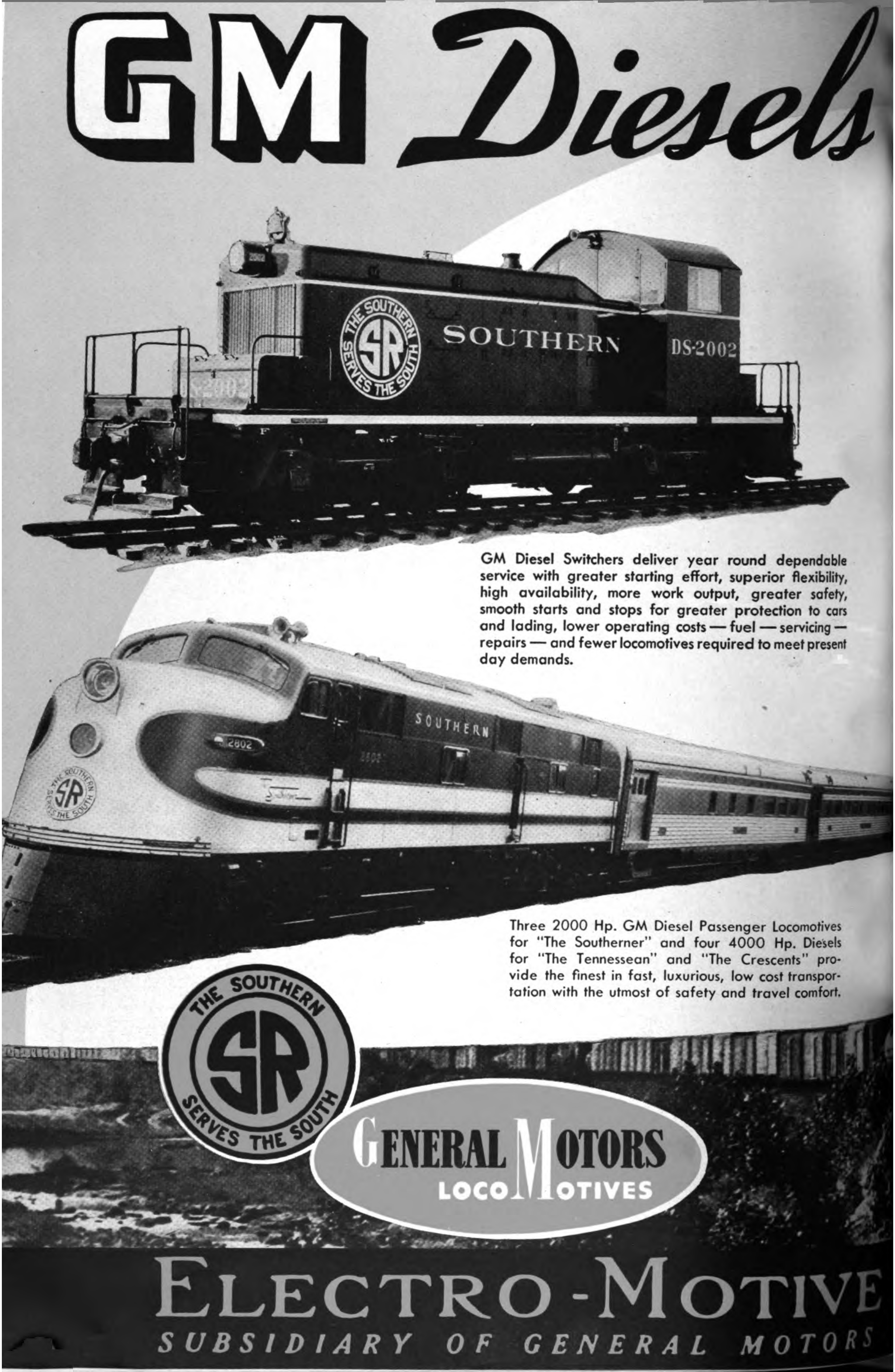
Freight-Car Inquiries

Aluminum Co. of America	100-200	70-ton hopper	....
Mesta Machine Co.	6	70-ton gondola	....
Mexico Northwestern	100	50-ton box	....
National Rwys. of Mexico	200	50-ton tank	....
Pittsburgh & West Virginia	100	50-ton box	....
U. S. Navy Dept.[5]	101	50-ton box	....
	61	50-ton flat	....
U. S. Navy Dept., Bureau of Supplies and Accounts	10	50-ton box	....
	15	50-ton flat	....
U. S. War Dept.	25-75	20-ton flat	....
	25-75	20-ton gondola	....
	50-200[6]	Box	....
	40[6]	Gondola	....
	40[6]	Flat	....
	25[6]	Comb. flat and caboose	....

Passenger-Car Inquiries

Reading[7]		Streamlined	Pass.-Train Car Equipment

[1] For January, 1942, delivery.
[2] For the Yunnan-Burma Railway in China.
[3] Federal court permission received. For February and March, 1942, delivery. Cost, $485,000.
[4] For the company's own use.
[5] Army-Navy munitions board preference ratings of A-1-a and A-1-b assigned to this equipment.
[6] For export to China.
[7] Reported to be considering the acquisition of this equipment.


GM Diesels
SOUTHERN
DS-2002
THE SOUTHERN SR SERVES THE SOUTH
GM Diesel Switchers deliver year round dependable service with greater starting effort, superior flexibility, high availability, more work output, greater safety, smooth starts and stops for greater protection to cars and lading, lower operating costs — fuel — servicing — repairs — and fewer locomotives required to meet present day demands.
SOUTHERN
2802
Three 2000 Hp. GM Diesel Passenger Locomotives for "The Southerner" and four 4000 Hp. Diesels for "The Tennessean" and "The Crescents" provide the finest in fast, luxurious, low cost transportation with the utmost of safety and travel comfort.
THE SOUTHERN SR SERVES THE SOUTH
GENERAL MOTORS
LOCOMOTIVES
ELECTRO-MOTIVE
SUBSIDIARY OF GENERAL MOTORS

For All Services

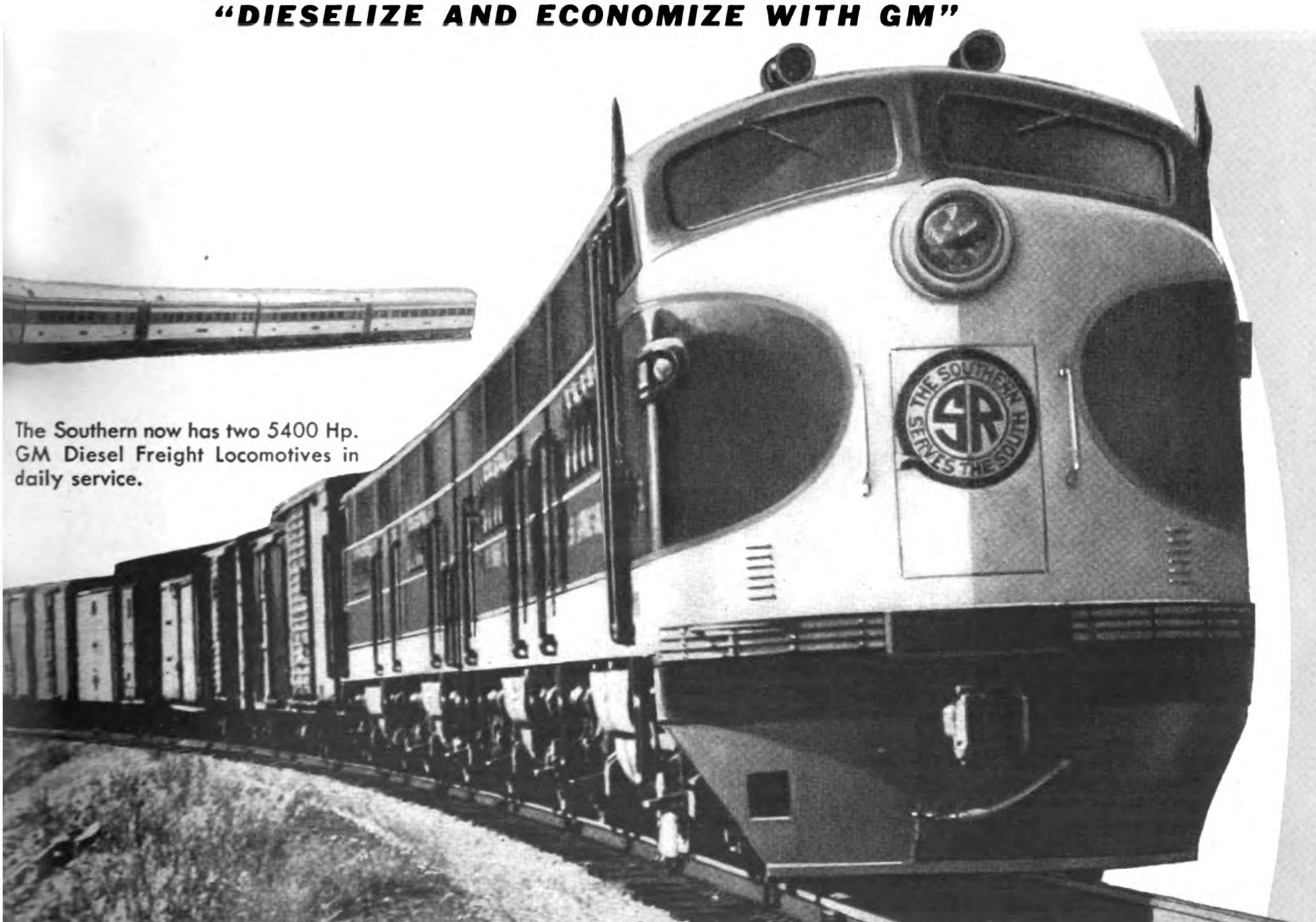
on the

SOUTHERN

THE SOUTHERN recently stepped into the lead as the first Eastern railroad to adopt GM Diesel freight locomotives and to use Diesel power for all classes of service.

GM Diesel freight Locomotives have already demonstrated remarkable reliability of performance, exceptionally high availability and the ability to haul greater tonnage on existing schedules or the same tonnage on faster schedules — resulting in marked reductions in operating costs . . . Never before in all railroad history has any type of motive power provided so many possibilities for greater operating efficiency and economies as the GM Diesel.

"DIESELIZE AND ECONOMIZE WITH GM"



The Southern now has two 5400 Hp. GM Diesel Freight Locomotives in daily service.

CORPORATION

LA GRANGE, ILLINOIS, U. S. A.

complaint—all of which were categorically denied by Pullman—follow:

(1) Defendants have secured a complete and unlawful monopoly of the business of operating sleeping-car services in interstate commerce over the railroads of the United States;

(2) Prices and terms charged by the defendants to railroads for sleeping-car services have been non-competitive;

(3) Prices and terms charged by the defendants to the traveling public for services operated by the defendants have been non-competitive;

(4) The defendants have secured an absolute monopoly over the business of manufacturing sleeping cars;

(5) Defendants have unlawfully restrained competition in the manufacture, sale, lease and distribution of sleeping cars and other types of passenger equipment;

(6) Defendants have forced railroads to pay non-competitive prices for cars;

(7) Defendants have unlawfully coerced and restrained railroads in the operation of their businesses and have unlawfully forced railroads to refrain from responding to the forces of competition;

(8) Defendants have stifled competition in the manufacture, sale, lease, and operation of modern, light-weight, streamlined, high-speed trains and rolling stock, and defendants have unlawfully retarded the growth and development of a supply of modern passenger coach and sleeping cars in the United States.

Supply Trade Notes

The American Swedo Iron Corporation, whose property was recently acquired by the present management, began operations on October 27 of this year. The company manufactures high-grade muck bars to specifications for staybolt, engine bolt and chain iron; low phosphorous melting bars; and skelp for pipe. The company's main office and plant are located at Danville, Pa., and a New York office maintained at 230 Park avenue, New York City. Harold T. Henry has been elected president and Eugene Brandeis, vice-president of the new company.

Obituary

Daniel L. Eubank, president of the D. L. Eubank Company, a railway supply sales agency, died at Atlanta, Ga., on November 24. Mr. Eubank was born at Churchville, Va., on November 24, 1869. He began his career in 1888 as a section laborer on the Chesapeake & Ohio and later served successively as locomotive fireman and engineman on that road until 1903. In that year he was appointed road foreman of engines. In 1911, Mr. Eubank left the railroad to become a service engineer of the Galena-Signal Oil Company and in 1919 was promoted to district manager of that company. In 1922, he was appointed its supervising service engineer, in which capacity he continued until 1932, when the business of the then Galena Oil Corporation was liquidated. He then established his own business as railway supply representative in which he was engaged at the time of his death.

D. L. Eubank

Mr. Eubank had long been active in organizations of railway and railway supply men. Since 1937, he had been the president of the Railway Supply Manufacturers' Association, the organization of exhibitors at Atlantic City in connection with the meetings of the A. A. R. Mechanical Division. He became a member of the executive committee of this organization in 1926 and served as vice president from 1930 to 1937. Mr. Eubank was formerly a member of the Traveling Engineers Association, and later belonged to the Railway Equipment Manufacturers' Association, the exhibiting organization associated with the T. E. A. He was president of this association in 1922. He had been treasurer of the Southern & Southwestern Railway Club since 1932.

◆

Henry F. Gilg, who was in the railway supply business in Pittsburgh, Pa., for a great many years, died on October 10. He was 82 years of age.

◆

A. H. Hudson, sales agent for the American Car and Foundry Company, died on October 30, at Upper Montclair, N. J.

Personal Mention

General

Frederick T. H. James, assistant to chief of motive power of the Delaware, Lackawanna & Western, has been promoted to chief of motive power, with headquarters as before at Scranton, Pa., to succeed Edward E. Root, who requested a leave of absence because of ill health. A photograph of Mr. James and a biographical sketch of his railway career were published in the July, 1941, *Railway Mechanical Engineer,* in connection with his appointment as assistant to chief of motive power at that time.

Shop and Enginehouse

A. G. Waldrupe, general foreman on the Southern at Knoxville, Tenn., has been promoted to shop superintendent at that point.

J. J. Viedeman has become erecting shop foreman on the Boston & Albany with headquarters at West Springfield, Mass.

William J. Mayer, blacksmith shop foreman on the Michigan Central Railroad at West Detroit, Mich., was retired on pension October 31, 1941. Mr. Mayer started as a machinist, October 23, 1899, and was promoted to inspector in 1901, and to foreman of the blacksmith shop in August, 1902. For a number of years Mr. Mayer was Secretary of the Master Blacksmiths' Association.

Car Department

D. Hendry, foreman of the freight car shops of the Canadian National at Transcona, Man., has been appointed superintendent of the car shops at Fort Rouge (Winnipeg), Man.

Master Mechanics and Road Foremen

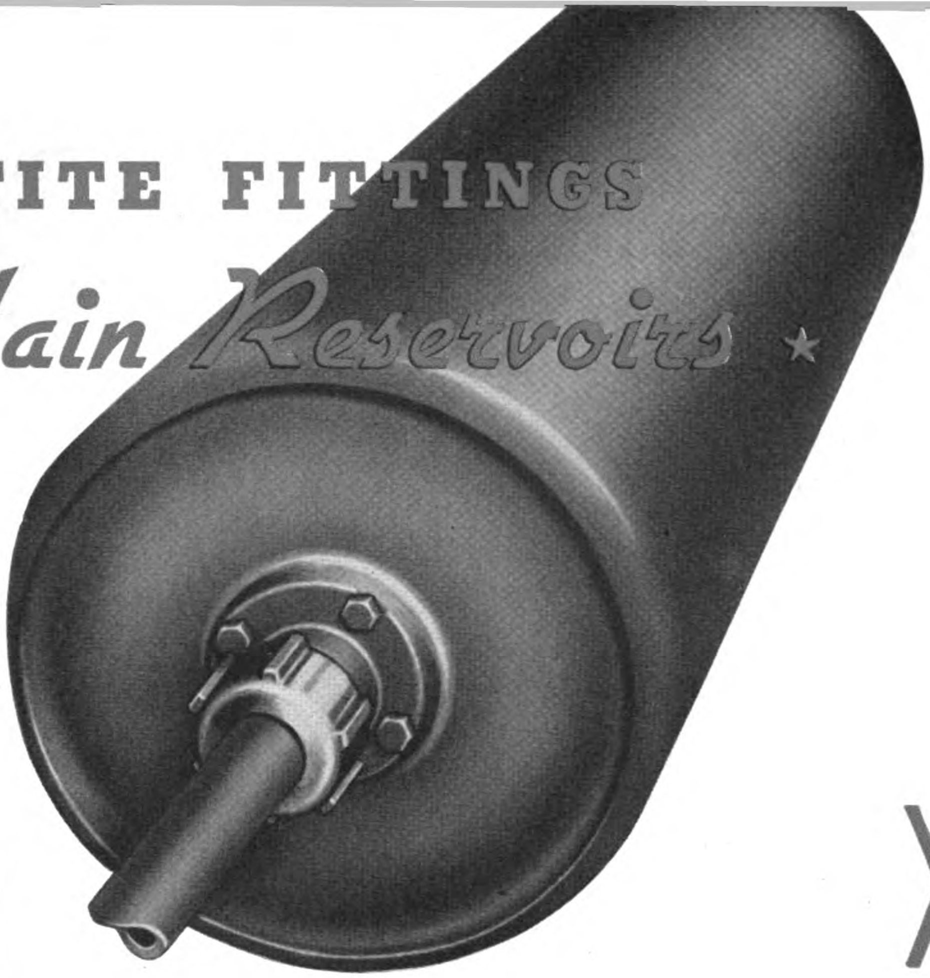
R. T. Hodges, shop superintendent for the Southern at Knoxville, Tenn., has been appointed master mechanic with headquarters at Sheffield, Ala.

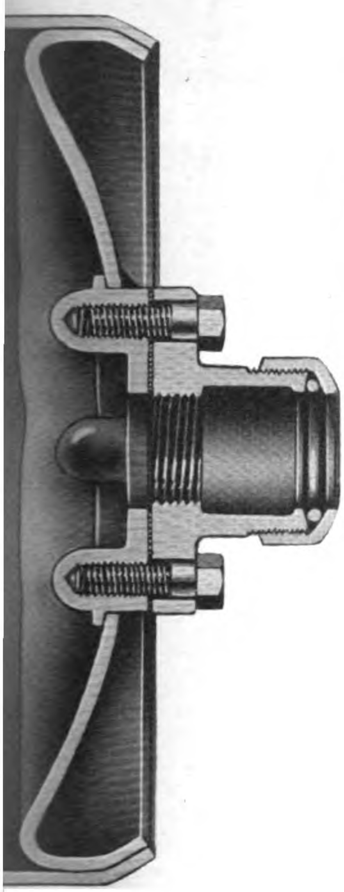
A. G. Gebhard, trainmaster on the Illinois Central at McComb, Miss., has been appointed master mechanic-Diesel and electrical equipment, a newly created position, with headquarters at Chicago.

Obituary

Alfred S. Poe, resident inspector in the test department of the Baltimore & Ohio, with headquarters at Pittsburgh, Pa., died suddenly on November 10 at the age of 57 years.

WABCOTITE FITTINGS for *Main Reservoirs* ★





Here Also, They Insure . . .
Unbreakable, *Leakless* Joints

You've been realizing the advantages of non-breakable leak-proof Wabcotite Fittings on vital pipe joints of all devices in modern air brake equipments. Why not use them on main reservoir connections as well? They are available for application here also. Stopping of air leaks at these joints will help prevent an overworked compressor, lengthen its service life, and reduce possibility of it being the cause of costly train delays. Have Wabcotite Fittings applied to the main reservoirs of your next lot of locomotives. It will be a sure paying investment.

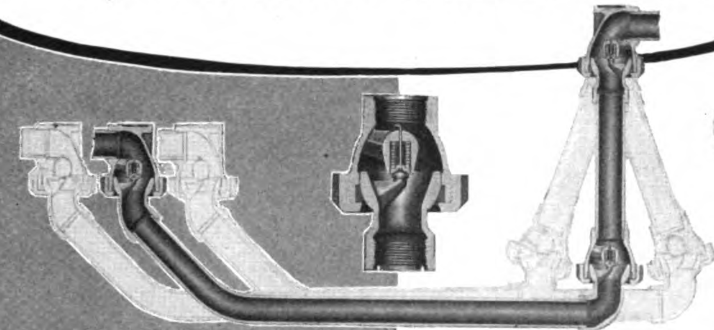
★

For every joint in any air brake equipment, where pipes unite, or branch, or attach to a device, there are suitable Wabcotite Fittings— tees, elbows, flanges, unions—available in a complete range of types and sizes. Among the thousands of these fittings now in service none has been known to break, leak, or require maintenance. » » »

WESTINGHOUSE . . .
AIR BRAKE COMPANY

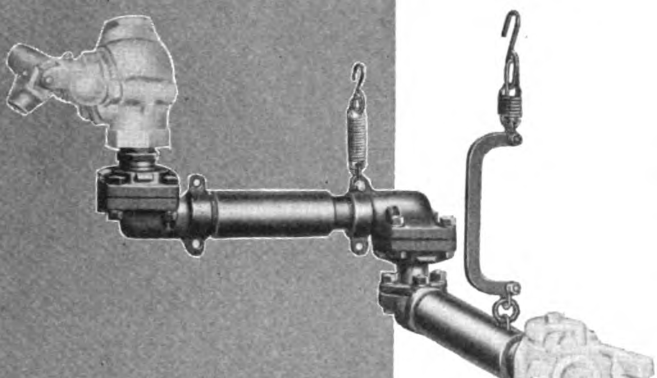
WILMERDING, PENNSYLVANIA

BARCO PRODUCTS INCREASE
Comfort – Safety – Efficiency of Nation's Finest Trains



BARCO ENGINE TENDER CONNECTIONS

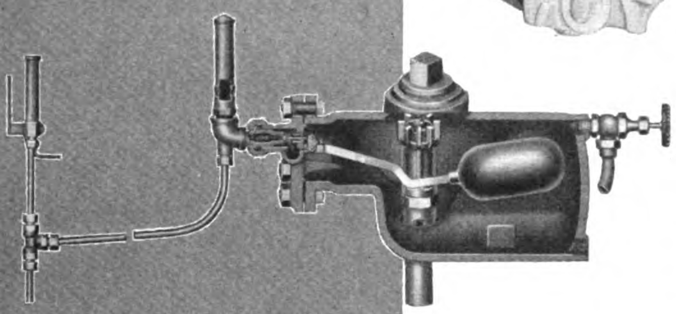
Bolted direct to Locomotive and Tender, require no manifolds — minimum number of 90° bends with steel wearing parts of alloy steel providing the utmost in safety, efficiency and low maintenance cost.



BARCO STEAM HEAT CONNECTIONS

For Passenger Cars and Rear of Tender

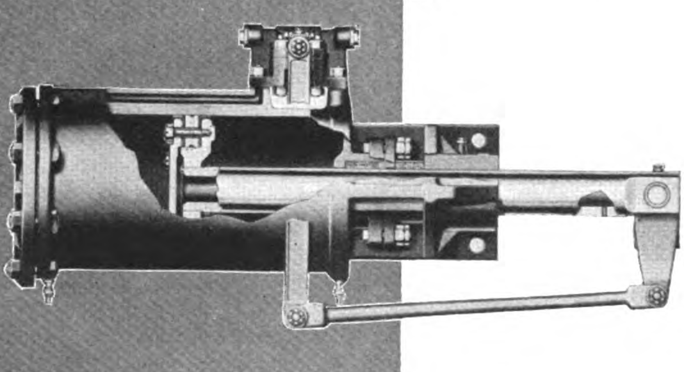
Metal wearing parts hardened alloy steel — only two wearing points per connection — maximum flexibility combined with simplicity and rugged construction provide maximum steam supply with minimum attention and lowest maintenance cost.



BARCO LOW WATER ALARM

Two-Whistle Float Type

Guards against engine failures — May be tested each trip in less than two minutes without any adjustments or disturbance of parts — Actuated solely by the height of the water above the crown sheet — depends on no other variables — Easy to Apply — Easy to Maintain.



BARCO POWER REVERSE GEAR

Provides the fine adjustment and precision-accurate control of locomotive valve motion essential to today's higher speeds. Maintains selected point of cut off — even a broken air supply pipe will not change the position.

BARCO UNIT TYTAMPERS

Now in Use on 78 Railroads.
6 Year's Satisfactory Service.
Used in Gang or Spot Tamping, Crib Busting or Breaking Ice or Frozen Ground or Cinders.
Low First Cost — Low cost of Maintenance.

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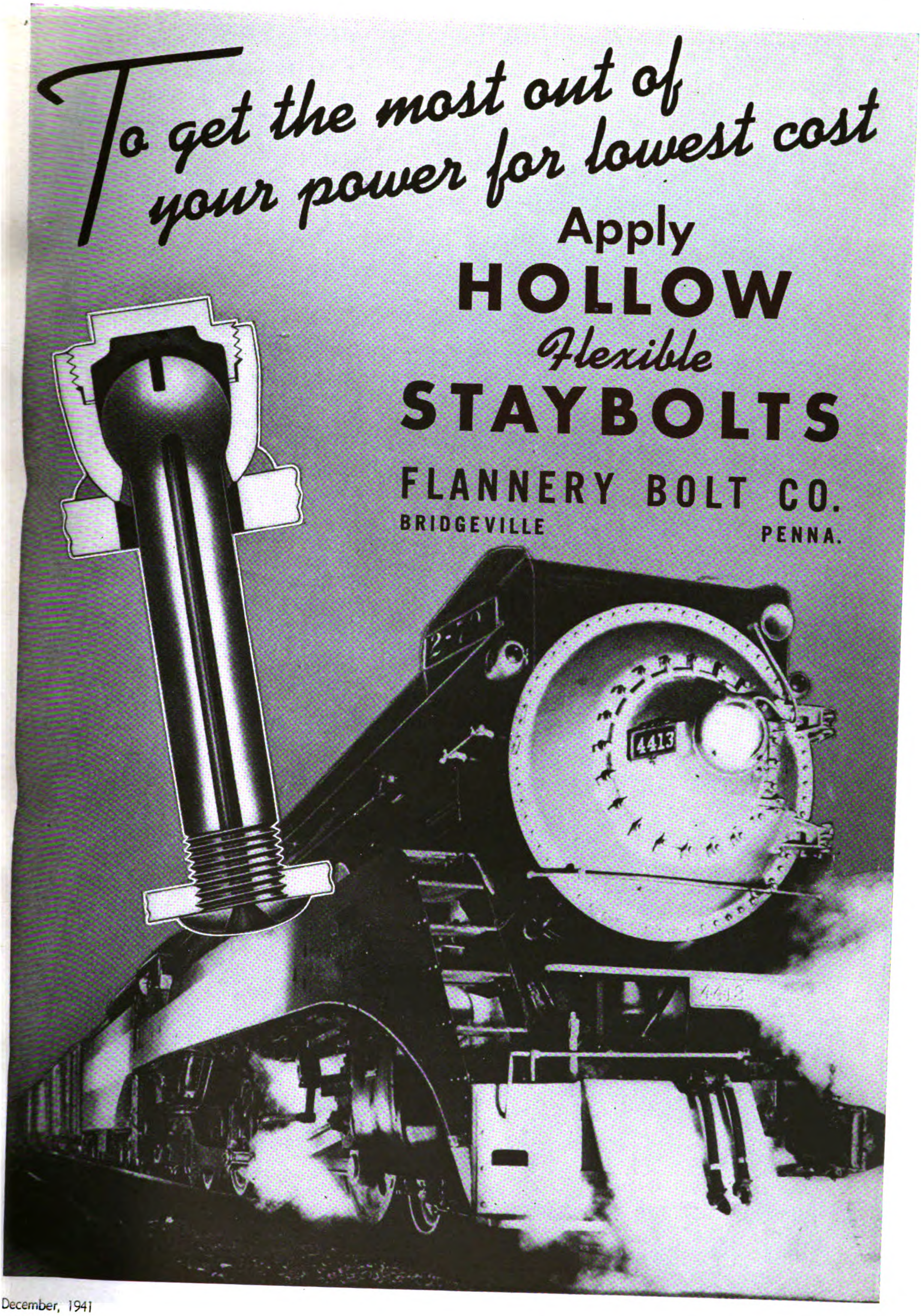
In Canada THE HOLDEN COMPANY, LTD.

Montreal — Moncton — Toronto — Winnipeg — Vancouver


To get the most out of your power for lowest cost
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INDEX TO ADVERTISERS
DECEMBER, 1941

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"Load 'em up and keep 'em rolling"

that's the kind of service COR-TEN Cars were built for!

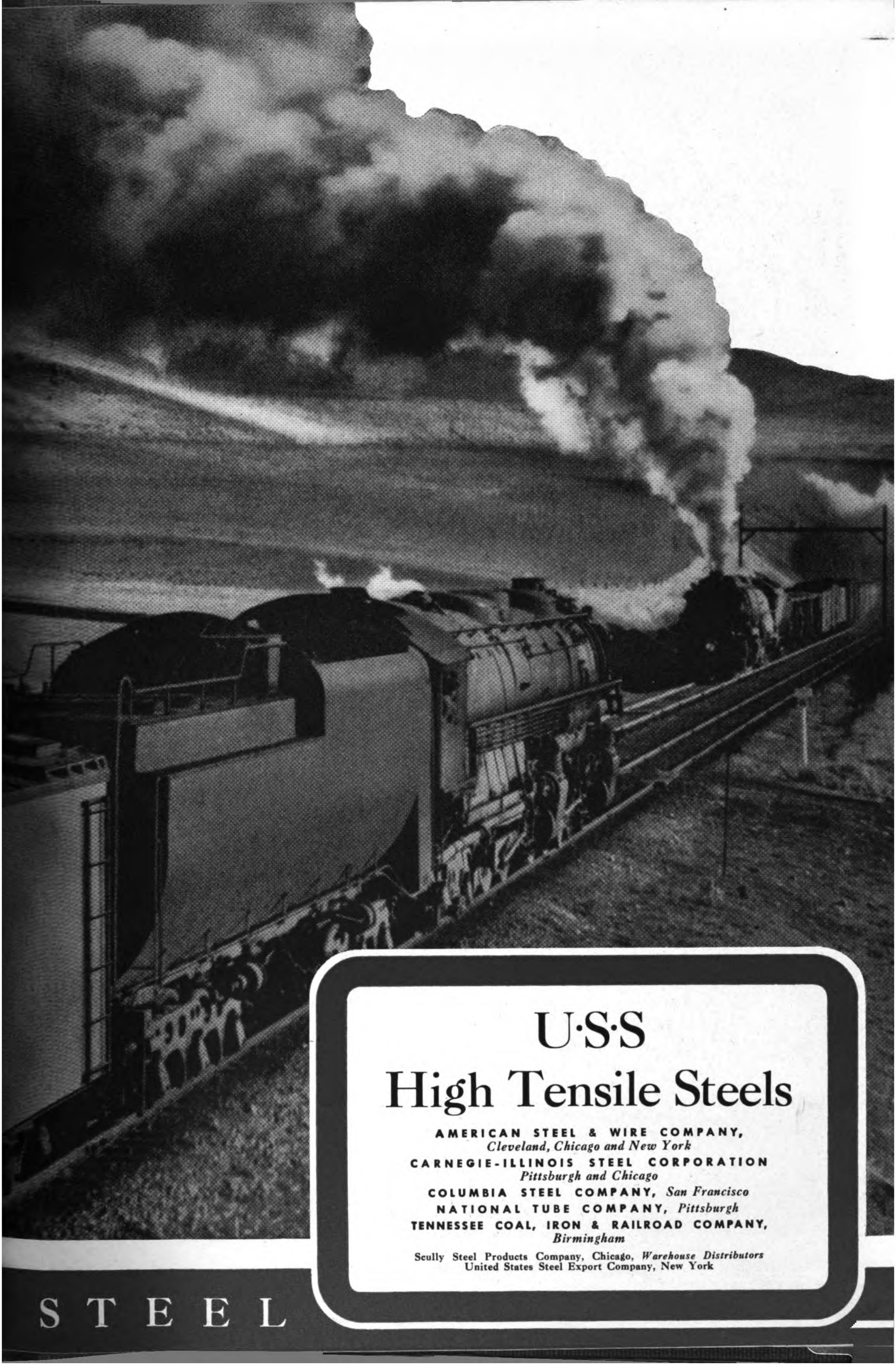
OWNERS of COR-TEN freight equipment have reason to pat themselves on the back today. For in their COR-TEN cars they've got just the sort of equipment that's needed to meet the record-breaking rush of traffic that's ahead. Here is big-capacity equipment that can be loaded to the guards —that's new and modern to roll safely at passenger train speeds— that's tough and strong to keep on rolling.

There are 43,026 of these COR-TEN freight cars in operation. Built from two to five tons lighter than conventional equipment they can carry an average of 2.56 tons more freight each. The 110,146 extra tons of carrying capacity they make available is equivalent to adding an extra 2,200 cars for freight hauling.

We ask you to watch the record that COR-TEN cars are making in this emergency, and when you plan your car-building program, plan to use U·S·S COR-TEN.

USS

UNITED STATES



U·S·S
High Tensile Steels
AMERICAN STEEL & WIRE COMPANY, Cleveland, Chicago and New York
CARNEGIE-ILLINOIS STEEL CORPORATION Pittsburgh and Chicago
COLUMBIA STEEL COMPANY, San Francisco
NATIONAL TUBE COMPANY, Pittsburgh
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Scully Steel Products Company, Chicago, Warehouse Distributors
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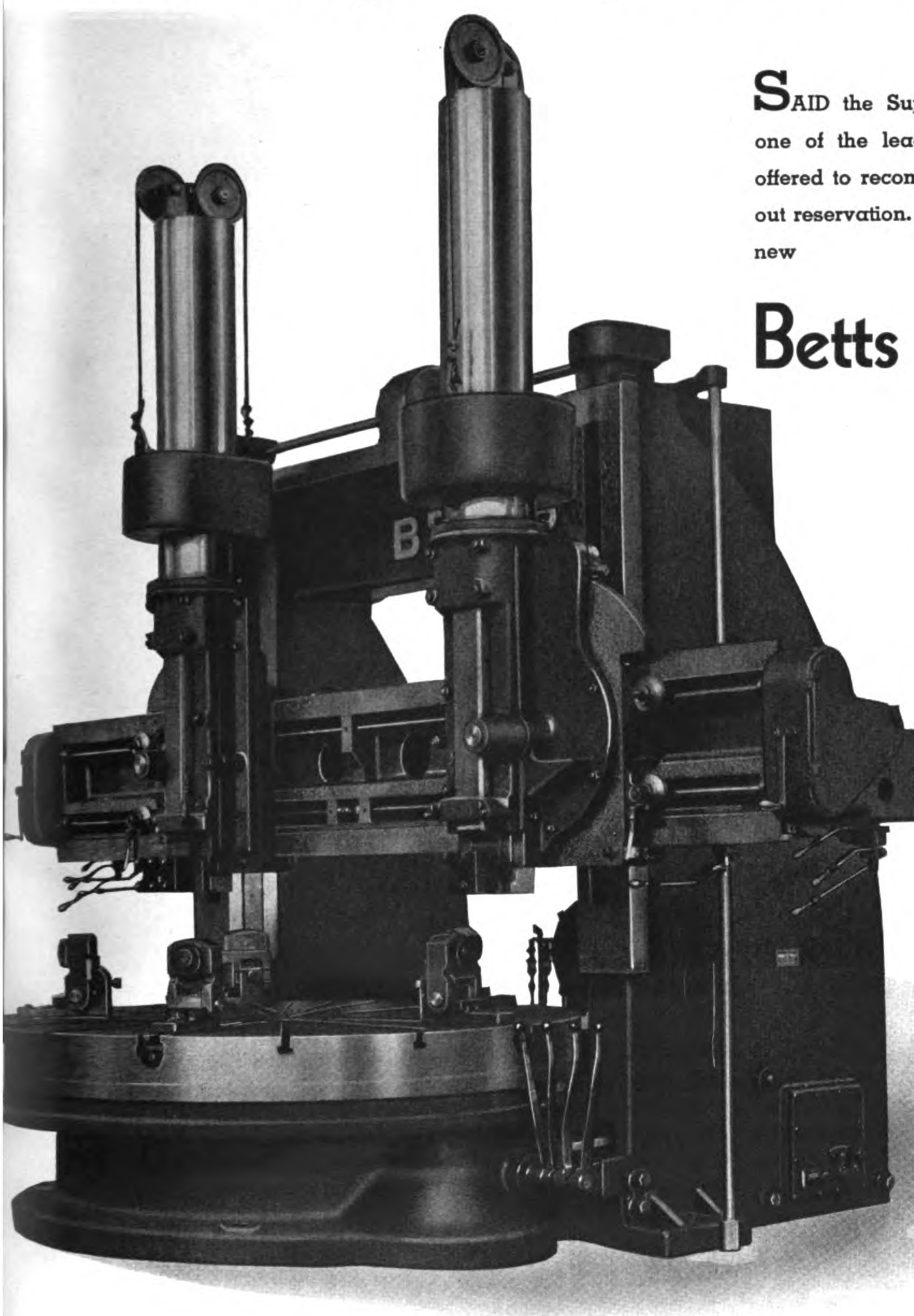
STEEL


PROTECTION
THE AMERICAN BRAKE SHOE


LeBLOND
CINCINNATI, OHIO
U.S.A.
Season's Greetings
from
THE R. K. LeBLOND MACHINE TOOL CO., CINCINNATI, OHIO
THE LARGEST MANUFACTURER OF A COMPLETE LINE OF LATHES

"Tire Mill running OK nothing but praise for it"



SAID the Superintendent of Shops on one of the leading Railroads. He also offered to recommend this Tire Mill without reservation. He was talking about this new

Betts Tire Mill

Installed in their shops in June. If you need a tire mill you should see one of these new Betts Tire Mills because it will open up new possibilities to you for extreme accuracy and mirror like finish on any work you can handle on a machine of this size.

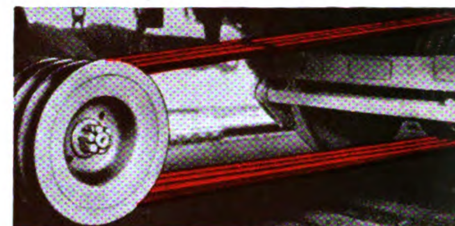
You will want to see one of these Mills in operation—write us.

BETTS • BETTS-BRIDGEFORD • NEWTON • COLBURN • HILLES & JONES • MODERN

CONSOLIDATED MACHINE TOOL CORPORATION
ROCHESTER, NEW YORK

Just 1 of Dayton's 4 Big Extras

PROMINENT RAILROAD SAVES THOUSANDS OF DOLLARS YEARLY ON BATTERY RECHARGING



"D-R" one-inch V-Belt Car Lighting Drive

$280 savings per car per year—that's important money in the face of today's rising operating costs. And it amounts to thousands of dollars annually when you multiply it by the number of cars operated by one prominent railroad.

That's what this railroad saves annually on battery recharging alone since it switched to Dayton 1" V-Belt Car Lighting Drives. What's more, these dependable, all-weather drives replaced belts which failed to last an average of one round trip in bad weather.

Dayton V-Belt Car Lighting Drives deliver trip after trip of trouble-free performance under all weather conditions. Battery life is longer . . . maintenance and service costs greatly reduced. Auxiliary equipment is protected because Daytons deliver constant, dependable power.

Unmatched for safe, economical performance, Dayton V-Belt Car Lighting Drives deliver the four big extra dividends of savings which more than pay for the cost of the drives themselves. Why accept less than the extras that only Dayton Drives deliver?

THE DAYTON RUBBER MFG. COMPANY
DAYTON, OHIO
Pioneers of Railway V-Belts and Connectors

GET Daytons AND GET THESE 4 Big Extras

EXTRA SAVINGS
in batteries
you never buy.

EXTRA SAVINGS
in maintenance
man-power released
for other work.

EXTRA SAVINGS
through protecting your
good will (and revenue)
from satisfied passengers.

EXTRA SAVINGS
in battery recharging.

Dayton

"D-R" V-BELT AXLE DRIVES
AND ENDLESS COG-BELT DRIVES

FOR CAR LIGHTING AND AIR
CONDITIONING EQUIPMENT

Made by the World's Largest Manufacturer of V-Belts

A Statement of Policy

THE policy of the American Locomotive Company and the General Electric Company is to work together on all problems of railroad motive-power application. American Locomotive has been manufacturing steam railroad motive power for a century. General Electric has been building electric locomotives for fifty years. Together we are also engaged in the manufacture and sale of diesel-electrics.

These factors place us in the happy position of being able to consider all types of motive power impartially and to recommend the type that is economically best suited to any particular application.

D. W. Fraser
PRESIDENT
AMERICAN LOCOMOTIVE COMPANY

C. E. Wilson
PRESIDENT
GENERAL ELECTRIC COMPANY

Alco

GE

STEAM

With the Alco "Big Boy" setting the pace — steam is pulling for profits better than ever!

THERE are places where a modern steam locomotive can do a better money-making job than anything else— places where its cost and availability characteristics are economically best suited to do the job.

Steam power is pulling many of America's most famous and most profitable trains. Impartial surveys by our two companies produce the facts to show where steam can be put to work doing an even bigger job. American Locomotive built its first steam locomotive 100 years ago, and today has more steam power in service than any other manufacturer.

Right now—among many others—the 30 largest steam locomotives ever built are rolling from its shops. They—like every other modern Alco product—have what it takes to make money.

DIESEL-ELECTRIC

The newest money-maker — and Alco-G.E. units are showing how much the diesel-electric can earn!

BUILT to be kept busy, the high availability of a diesel-electric is evidence of the way it can keep on the job. This ability makes possible faster schedules with fewer locomotives and fewer servicing facilities.

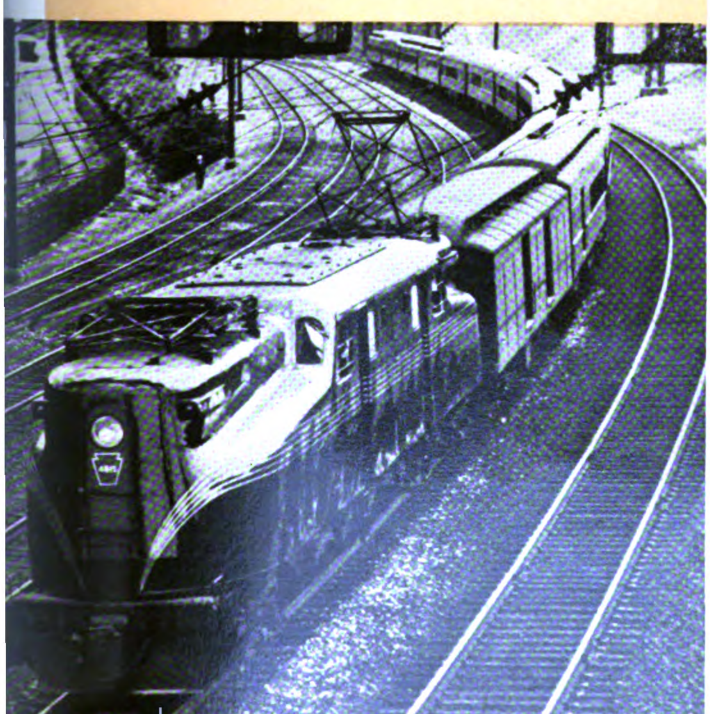
The first Alco-G.E. diesel-electric was built in 1925. It is the forerunner of hundreds of Alco-G.E. switchers that are proving you can't beat diesel-electrics on a switching job.

Switching is a round-the-clock job, and the exceptional availability of an Alco-G.E. switching fleet enables it to get more work done and at less cost.

On the mainline, operators are showing what the diesel-electric's speed can do in turning profits upward. They are finding the public likes the diesel-electric ride, and that these modern giants, within the limits of their self-generated power, are taking advantage of electric drive's high availability, economy, and long life.

ELECTRIC

— Moving dense traffic at high schedule speeds, the electric keeps on setting top performance records!



THE electric locomotive is supreme in dense-traffic service. Its overload capacity enables it to exert power considerably in excess of its continuous rating for short periods of time. Therefore, by accelerating rapidly and negotiating relatively short grades on a rolling profile at sustained speeds, the electric moves the most tons per hour. This same overload capacity permits longer, heavier trains. Low maintenance, high availability, low power costs, and interchangeability between passenger and freight service combine to get the job done at lowest cost with the fewest locomotives.

In mountain operation, the extra pulling power and the regenerative braking of electrics make possible faster schedules both up grade and down. And they provide the only smoke-, gas-, and dirt-free power for tunnel operation.

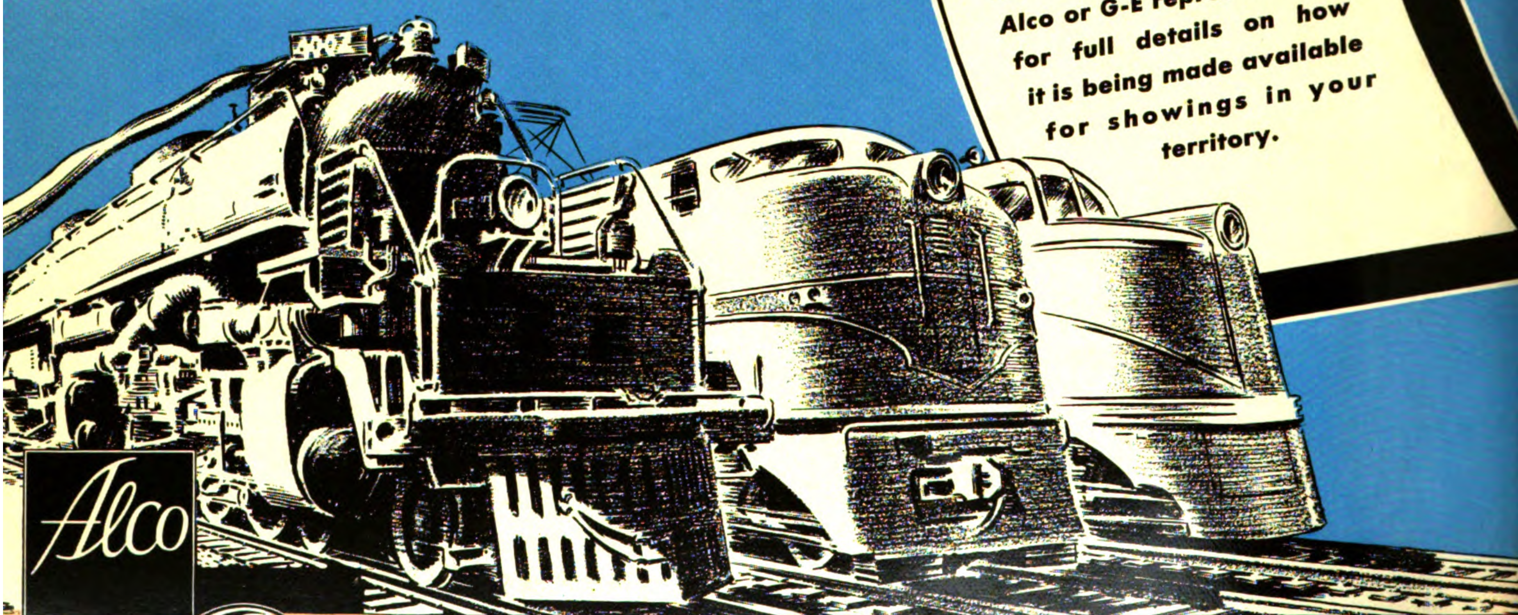
BEFORE YOU BUY NEW MOTIVE POWER

TAKE ADVANTAGE OF THE IMPARTIAL ADVISORY SERVICE ALCO AND G.E. CAN GIVE YOU

WE'LL be glad to help you survey your system to find the type of power — steam, electric, or diesel-electric — that is economically best suited to your needs. And in each type of power we can furnish equipment to do the job right.

We've been building motive power to meet your needs for 100 (Alco) and 50 (G.E.) years. Why not test the value of that experience? Get in touch with either your Alco or your G-E representative.

HAVE you seen the new Alco-G.E. full-color-and-sound motion picture, RAILROADIN'? Ask your Alco or G-E representative for full details on how it is being made available for showings in your territory.



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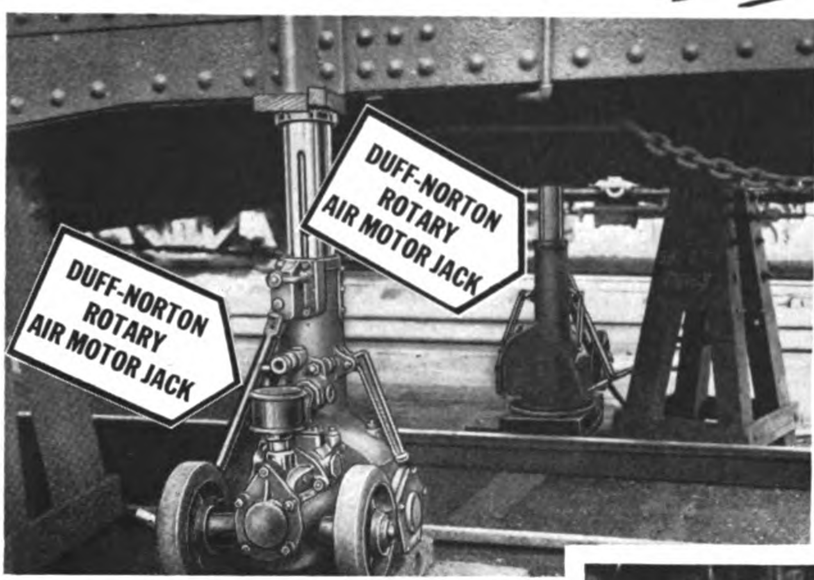
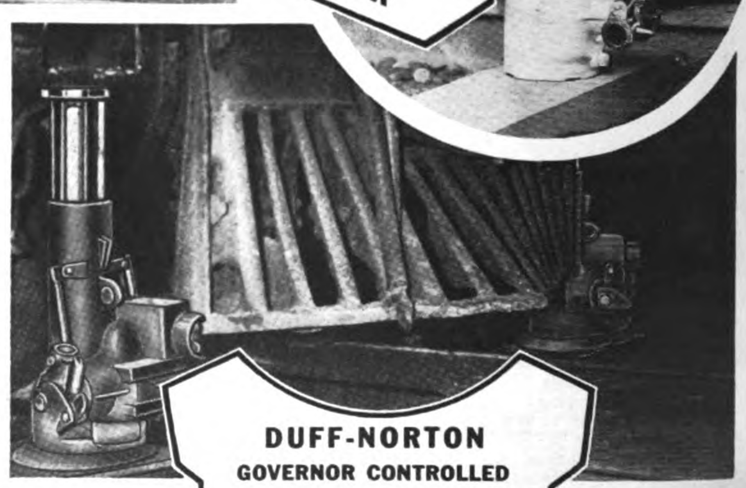
Working Side-by-Side to Save You Money

AMERICAN LOCOMOTIVE and GENERAL ELECTRIC

TO THE RAILROAD OFFICIALS OF AMERICA...
We Have Witnessed the Part Speed Plays in the Modern "Blitzkrieg." Why Then Should Not Similar Speed Be Applied To Railway Freight?
SPEEDY MOVEMENT of freight is an absolute essential to the successful fulfillment of our entire National Defense Program.
Yet the possibility of a serious freight congestion exists, despite the fact that railroads are doing a magnificent job in handling more freight, with fewer cars, than in previous peak years.
Freight congestion can form a highly dangerous bottleneck to all of our Defense activities.
The solution to the problem lies simply in the adoption of "one-speed" railroading, with freight trains traveling at the speed of passenger trains.
Incorporate in freight cars, the same engineering principle that has made possible the speed of our modern streamliners and locomotives—the adoption of roller bearings.
Higher speeds and heavier loads simply are not possible with freight cars, so long as they use plain friction bearings.
Roller Bearings reduce starting resistance of individual cars 88 per cent; cut maintenance costs; increase life of equipment; eliminate hot-box delays; improve fuel economy; increase hauling capacity; make possible fast, on-time schedules; reduce claims for damage to lading; greatly reduce in-shop-for-repair time.
Now is the time to bring "blitzkrieg" methods to the speeding-up of freight shipping—to do away with obsolete equipment in railroading as in every other phase of National Defense.
THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO
TIMKEN
TRADE-MARK REG. U. S. PAT. OFF.
RAILWAY ROLLER BEARINGS
TIMKEN Tapered Roller BEARING EQUIPPED
Manufacturers of Timken Tapered Roller Bearings for automobiles, motor trucks, railroad cars and locomotives and all kinds of industrial machinery; Timken Alloy Steels and Carbon and Alloy Seamless Tubing; and Timken Rock Bits.

MODERN DUFF-NORTON JACKS ...HELP YOU *Speed up* YOUR REPAIR and MAINTENANCE SCHEDULES





As a vital element in our defense program, Industry looks to the Railroads to keep things moving. And so, throughout the railroad industry, "SPEED" is the word of the day! In roundhouses and car shops everywhere, Duff-Norton Jacks are helping make new records in the repair and maintenance of rolling stock.

Husky Duff-Norton Jacks are easy to move and spot, easy to operate, fast raising and lowering, economical and absolutely safe and dependable.

Put Duff-Norton Jacks to work in your shops, and speed up your repair and maintenance schedules. We'll be glad to rush you full information on the complete line of modern, efficient Duff-Norton Jacks.

"THE HOUSE THAT JACKS BUILT"

THE DUFF-NORTON MANUFACTURING CO.
PITTSBURGH, PA.
Canadian Plant: Coaticook, Quebec

TIME IS SHORT

★

• Time is short—a nation arming against aggression has none to spare. But fast as the seconds tick, the hammers at Williams keep forging; turning out a ceaseless stream of the tools our country needs. To this course we are pledged; to this end we labor 'round the clock. But as we work, our search for better ways and greater skill continues. Time is short, but all of it is being used at Williams.

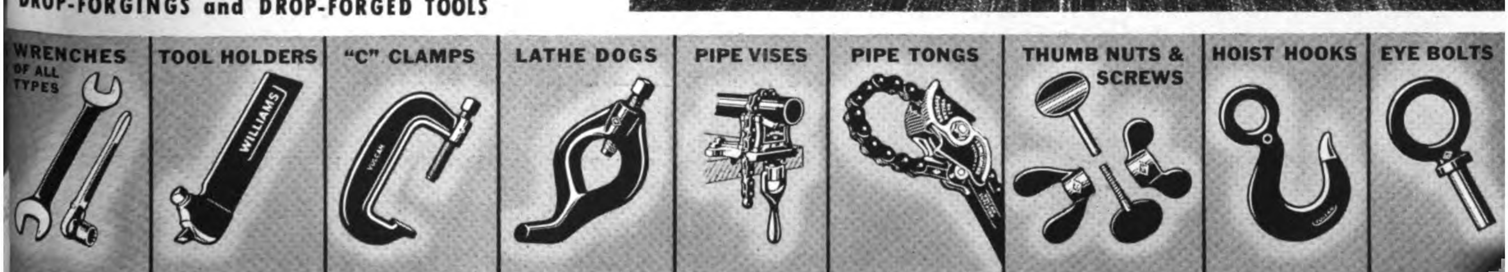
★

J. H. Williams & Co., 225 Lafayette St., New York

WILLIAMS

SUPERIOR DROP-FORGED TOOLS

Headquarters
for over half a century for
DROP-FORGINGS and DROP-FORGED TOOLS



Baker Elevating Truck pulling out car truck for repair.

Baker Low-Lift Truck with a 5200 lb. skid-load of journal brass.

Baker Crane Truck removing stoker from tender for repair.

BAKER TRUCKS *step up material handling efficiency*

Removing air compressor with a Baker Crane Truck.

Baker Low-Lift Truck specially built for handling LCL containers.

Baker Crane Truck applying car frame to wheels.

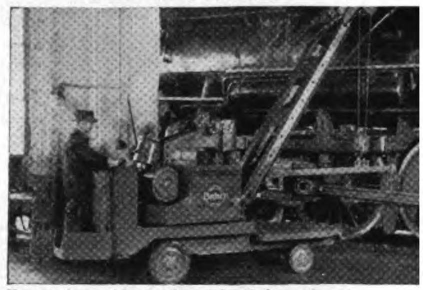
Baker Platform Truck carrying baggage and express in a busy terminal.

● Railroads, faced with the immediate problem of gearing their activity to the increased demands of the Defense Program, are finding the solution in mechanizing material handling with Baker Trucks. Maintenance work in shops is speeded up by faster removal, transportation and application of heavy parts. Stores are making faster deliveries to yards, shops and stations. Terminals are handling freight and baggage in a fraction of the time formerly required.

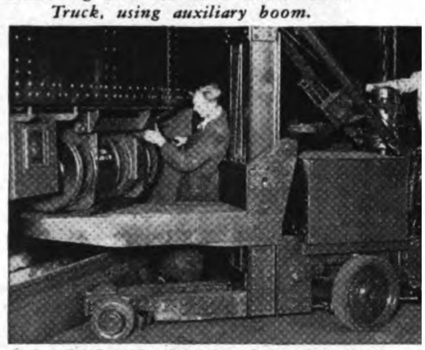
● *Let the Baker representative near you show how Baker Trucks can be used to best advantage on your road. Or write us direct.*

BAKER INDUSTRIAL TRUCK DIVISION
of the Baker Raulang Co.
2172 WEST 25th STREET • CLEVELAND, OHIO

Baker Utility Truck servicing air-conditioned Pullman cars.



Removing side rod with Baker Crane Truck, using auxiliary boom.



Baker Hi-Lift Truck makes this awkward job simple and quick.

Baker Truck loads 45 kegs of nails into box cars at one trip.

Baker 3-wheel Tractor pulling a 12 trailer train in a freight terminal. ●

I-R

Baker INDUSTRIAL TRUCKS

In Canada: Railway and Power Engineering Corporation, Ltd.

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FOR SALE

Classified Advertisements—Help and Situation Wanted advertisements appearing in the "Get Together Department," 10c a word an insertion. Minimum charge $2.00 for each insertion. For Sale Advertisements $10.00 a column inch. Any number of inches may be used. Copy must be in this office by the 10th of each month preceding to insure insertion in the issue.

Have You Changed Your Address?

•

Notice of change of address of subscribers should reach the office of Railway Mechanical Engineer, 30 Church St., New York, ten days in advance to insure delivery of the following issue to new address. In sending notification of change always include the old address as well as the new.

Name ....

Old Address ....

New Address ....

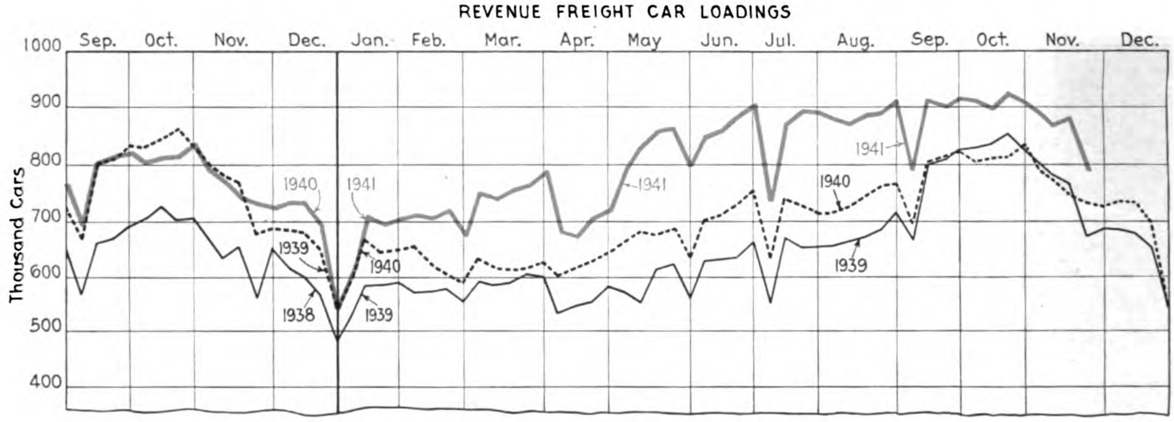
Position .... Company ....

....

THE EDITOR'S DESK

STRATEGIC IMPORTANCE OF THE RAILWAYS

Railway officers and railway supply manufacturers are deeply concerned over the material situation, both for new facilities and equipment and for maintenance and repairs. Freight car the five-year period. Complete November figures are not yet available, but for the three weeks ending November 15, the loadings were 84 per cent of the five-year average.



loadings are continuing to maintain a high level and undoubtedly will severely tax the capacity of the railroads this winter, particularly if bad weather conditions are encountered. National defense production is speeding up steadily and while freight car loadings have fallen off from the October peak, they are now running at a much higher level proportionately, than they were in September and October, and except for unforeseen circumstances, will undoubtedly continue to do so.

The Railway Age, in a recent editorial, compared freight car loadings with the average loadings for the same months during the five-year period 1925-29, inclusive. In August of this year the car loadings were 82.5 per cent of the five-year average, in September 79.6 per cent, and in October 79.1 per cent. In November, however, although the actual car loadings were lower than those in October, they showed a marked increase in percentage over those for

The New York Herald-Tribune compares the loadings each week with the average for the same week for the preceding ten years. The percentage increased from 121 for the week ended October 11, to more than 132 for the weeks ending November 15 and November 22.

This stiffening up of the traffic curve, as we come into the winter months, presents no uncertain challenge to maintaining the equipment in the best possible condition, and to adding new equipment as rapidly as conditions will permit — the builders are far behind their schedules at the present time.

Railroads are a vital link in the national defense chain. Apparently some of them are more fortunate in securing materials and equipment than others. It is the squeaking wheel that gets the grease and no possible effort should be overlooked in awakening the authorities to allocate strategic materials where they are so vitally needed.

Roy V. Wright


SELLERS TYPE "S" INJECTOR
THE MODERN INJECTOR
IN maintenance alone Sellers Type "S" Injector is less than a third as expensive as old style injectors. The reason — its design eliminates bulged steam pipes and broken injector parts caused by water hammer and reduces scaling to a minimum.
Its many other advantages include more than 75% reduction in water waste when starting and stopping; one lever which controls all operations; the ability to drain water tank completely, when necessary, and a combination lifting and non-lifting principle which permits it to be located high above roadbed hazards.
WM. SELLERS & CO., INCORPORATED, PHILADELPHIA, PA.
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